

Allergy in the Mediterranean area

I. Pollen counts and pollinosis of Montpellier

J. BOUSQUET*, P. COUR†, B. GUERIN‡ and F. B. MICHEL*

*Clinique des Maladies Respiratoires, Hôpital l'Aiguelongue, CHU, 34059-Montpellier-Cedex, France, †Laboratoire de Palynologie (Directeur Madame Van Campo), Centre National de la Recherche Scientifique, Place E. Vieleton, 34000 Montpellier, France and ‡Laboratoire des Stallergènes, 160 Quai de Pollengis, 94 Joinville-Le-Pont, France

(Received 19 January 1983; accepted for publication 14 February 1983)

Summary

The climatic conditions of the Mediterranean area results in vegetation and pollen very different from that of the other parts of Europe. The pollen content of the atmosphere of Montpellier, southern France, was examined using a filter sampler which was shown to be more efficient than most of the current devices for air sampling. Pollen counts were subsequently compared with pollinosis of patients born and living in and around Montpellier. The mean annual pollen counts showed that grass pollens and Cupressaceae pollens (cypress and juniper) are the highest. Some Mediterranean pollens (Oleaceae, London plane, *Parietaria*) are also important. Plantain and oak pollens are also present in relatively large amounts.

Grass pollen allergy was found to be present in 86.5% of pollen-allergic patients. It was followed by plantain, *Parietaria*, Oleaceae, London plane and Cupressaceae pollens which were allergenic in 13–36% of pollen-allergic patients. Oak and pine pollens were present in large quantities in the counts but few persons were sensitive to oak and none to pine. By contrast, some patients had positive skin tests to alfalfa, red clover, acacia and lime tree pollens though these pollens were almost absent from the counts. In a few cases local sources of these pollens could account for the positive skin tests but cross-sensitivities could also occur. In summary, pollinosis of the Northern Mediterranean area is intermediate between the southern part of the area and the other parts of Europe.

Introduction

The climates of Europe are split approximately into bands from the north to the south (Charpin & Surinyach, 1974). The Mediterranean climate is characterized by the

Correspondence: J. Bousquet, Clinique des Maladies Respiratoires, Hôpital l'Aiguelongue, CHU, 34059 Montpellier, France.

mildness of its winter, the summer dryness and a rainfall usually less than 1 m. These climatic conditions make it possible to define a typical Mediterranean vegetation. Pollinosis in Mediterranean zones is therefore very different from that of other parts of Europe. In some limited areas of Western Australia, South Africa, Chile and California there appears to be a similar climate with more or less similar vegetation.

Pollen calendars of cities located around the Mediterranean have already been presented (Aubert, Charpin & Charpin, 1959; Centanni, Rivosecchi & Businco, 1959; Charpin *et al.*, 1960; Charpin, Aubert & Charpin, 1962, 1965; Charpin, Surinyach & Frankland, 1974; Liebeskind, 1960; Mallea *et al.*, 1980; Serafini, 1957; Surinyach, 1960; Tas, 1965). In all these studies, either the Hirst spore trap (Hirst, 1952) or the Durham gravimetric apparatus (Durham, 1946) was used. In most studies already published only the number of pollen grains have been taken into account.

In Mediterranean areas some pollens have a particular importance. *Parietaria officinalis* (pellitory of the wall) pollens appear to be a unique feature of the Mediterranean pollinosis although these plants are not restricted to the Mediterranean zones. (Charpin & Charpin, 1981). Other pollens are also common and important as allergens: *Platanus orientalis* (London plane), Oleaceae (ash, olive, privet and *Phillyrea angustifolia*, a common bush) (Aubert *et al.*, 1959; Michel *et al.*, 1978a) and Cupressaceae (cypress, thuya and juniper) (Tas, 1965; Charpin *et al.*, 1960, 1974). In the south of the Mediterranean zone, Amaranthaceae and Chenopodiaceae are of relevant importance (Lindenbaum, 1966; Cambon, 1982). The prevalence of grass pollens decreases from the north to the south of the area.

The methods of airsampling usually have many defects (Solomon & Matthews, 1978) and are not very quantitative. In 1968, a new pollen trap was devised. It consists of a filter sampler in which collected pollens are dissolved in strong acidic solutions and subsequently examined under a microscope. (Cour, 1974; Cour *et al.*, 1983; Michel *et al.*, 1976). The analyses were found highly quantitative and pollens present in very small quantities could only be detected with this technique (Cour *et al.*, 1980). Moreover, the results of the analyses are not only available in counts or percentage of pollens but also in weights since the size of pollen grains ranges from 15 μm to more than 70 μm demonstrating that the number of pollens inhaled by a patient can be very different from the amount of pollens.

By means of the P. Cour filter sampler (Cour, 1974; Cour *et al.*, 1983) the pollen rain of the Montpellier area was analysed over a period of 3 years (1978–1980). The results of the pollen calendars are given in annual percentage of pollens and in weight of pollens inhaled yearly by a patient. The results of the pollen calendars were compared with skin tests of patients born and still living in and around Montpellier in order to determine the pollinosis of that area.

Materials and methods

Pollen counts

Pollens in the air are captured by means of a filter made from gauze layers dipped into silicone oil. After a week of exposure the layers are dissolved in sulphuric acid and the recovered pollens are submitted to acetolysis according to the procedure of Cour (1974). From 1000 to 10 000 grains are counted for each analysis according to the diversity of the pollens. The data obtained were analysed by computer. The results of 3 years of pollen counts in the Montpellier atmosphere were averaged: 1978–1980. For

each taxon, the percentage of pollens caught every year by the filters and the weight of pollens per 3500 m³ of air are given. The weight of pollens was calculated according to the mean size and the shape of the pollen grains. The weight of pollens was given for 3500 m³ of air by extrapolation from the breathing patterns of man. According to Fishman (1980) the typical volume of air breathed by a 20 year old, seated man, height of 165 cms, weight of 64 kg and a body surface area of 1.7 m² is 6.00 l/min, i.e. 8.64 m³/day and 3153 m³/year. Thus 3500 m³ of air corresponds approximately to the volume of air breathed by an adult every year.

Pollinosis

Pollen allergy was examined only in patients who were born in the Montpellier area and who had been living in the same area since birth. All the patients who attended the Allergy Department of the Chest Clinic of the Montpellier Medical School and fulfilled these criteria were investigated over a period of 1 year, to avoid possible seasonal differences which are frequent in pollen allergy. Allergy was determined by means of modified prick tests and when possible by the titration of pollen-specific IgE antibodies.

Prick tests were made with 5% (w/v) glycerinated extracts obtained from Stallergènes Laboratories (Fresnes, France). The prick test was considered positive when the weal size of the allergen was greater than 80% of that of 5% codein phosphate used as a positive control (Menardo, Bousquet & Michel, 1982). The screening of the pollens tested by prick tests was derived from the results of the pollen calendars, and specific extracts were made when the percentage of pollen taxons was over 1% of the total annual pollen rain, with the exception of *Mercurialis annua* since it was not possible to find this pollen in sufficient amounts to make extracts. Moreover all common pollens used for screening were also tested to find out possible unrecognized cross-reactivities. Cross-allergenicity was finally taken into account. A five-mixed grass pollen extract containing cocksfoot (*Dactylis glomerata*), perennial ryegrass (*Lolium perenne*), Bermuda grass (*Cynodon dactylon*), timothy grass (*Phleum pratense*), and meadow fescue (*Festuca elatior*) was used to detect grass-pollen allergy as some of them do not completely cross-react (Leiferman & Gleich, 1975). A mixed cereal pollen extract containing oat (*Avena sativa*), wheat (*Triticum* spp.), maize (*Zea mays*) and rye (*Secale cereale*) completed the grass extract. For Oleaceae pollens, only olive pollen was employed since there appears to be a strong cross-allergenicity among all Oleaceae pollens of relevant importance of the Mediterranean zone (olive, *Olea europaea*; ash, *Fraxinus exselsior*; privet, *Ligustrum vulgare* and *Phillyrea angustifolia*) (Bousquet *et al.*, 1983). For Cupressaceae pollens, cypress and juniper (*Cupressus sempervirens* and *Juniperus communis*) were mixed, so were Japan mulberry (*Broussonetia papyrifera*) and white mulberry (*Morus albus*). However, *Parietaria officinalis* and nettle (*Urtica dioica*) were tested separately since, although belonging to the same family (Urticaceae), they do not seem to cross-react (Hewitt *et al.*, 1983). The list of pollens tested by prick tests is given in Table 1, though in the Table the term Graminae designates nine grass and cereal pollens examined by prick test.

When RAST discs were available commercially from Pharmacia Laboratories (Uppsala, Sweden) the titration of serum pollen-specific IgE antibodies was determined by the classical RAST procedure. The list of IgE tested is given in Table 1.

On very rare occasions there was a discrepancy between prick tests and RAST, in which case the patient was either discarded from the study to avoid possible errors or a

Table 1. Total results of pollen calendars and pollinosis of the Montpellier area

Botanical order	Name (species or family)	Pollen calendar			Skin tests			
		peak	%	mg/year	A	B	C	RAST
Gymnosperms	<i>Cupressus</i>	1500-4000	15.2	2.89	15.2	3.6	1.5	+
	<i>Juniperus</i>							
	<i>Pinus</i>							
Spadicifloral	<i>Chamaerops humilis</i>	400-1000	6.6	2.60	0	0	0	
Glumella	Graminae	100-200	14.1	4.33	86.5		29.7	+
Amentaceous	<i>Alnus</i>	20-90	0.5	0.04	1.5	0	0	+
	<i>Betula</i>	5-200	0.4	0.07	3	0.7	0	+
	<i>Carpinus</i>	1-10	0.1	0.02	2.6	0	0	
	<i>Castanea</i>	55-300	2.1	0.13	4.9	0	0	
	<i>Corylus</i>	1-5	0.01	<0.01	0.4	0	0	+
	<i>Fagus</i>	1-10	0.1	0.04	0.7	0	0	
	<i>Juglans</i>	0-5	0.01	<0.01	0	0	0	
	<i>Populus</i>	10-30	0.6	0.06	0.7	0	0	
	<i>Quercus</i>	100-800	12.7	1.28	6.8	1.5	0	+
	<i>Salix</i>	7-15	0.2	0.02	2.3	0	0	+
Urtical	Moraceae	50-600	2.1	0.04	5.6	2.3	0.7	
	<i>Ulmus</i>	15-25	0.4	0.56	2.6	0.4	0	+
	Urticaceae	15-90	3.1	0.05	27.1	6	2.2	+
					5.6	0.4	0	
Polygonal	<i>Rumex</i>	8-20	0.4	0.03	5.3	0	0	
Centrospermal	<i>Amarantus</i>	5-35	1.9	0.05	3.4	0.7	0	
	<i>Beta</i>				5.3	0	0	
	<i>Chenopodium</i>				6.4	0.7	0	+
Malval	<i>Brassica</i>	0-5	0.01	<0.01	3.0	0	0	
Parietal	<i>Tilia</i>	0-1	0.01	<0.01	6.8	2.6	0	
Euphorbial	<i>Buxus</i>	1-45	0.4	0.05	0.7	0	0	
Therebinthal	<i>Pistacia</i>	2-10	0.01	<0.01	0	0	0	
Sapindal	<i>Acer</i>	2-10	0.05	0.01	2.3	0	0	+
	<i>Aesculus</i>	0-5	0.01	<0.01	7.9	0.4	0	
Celastral	<i>Vitis</i>	2-20	0.05	0.05	0.5	0	0	
Rosal	<i>Acacia</i>	0-5	0.01	<0.01	2.6	0	0	
	<i>Acacia verek</i>	0-5	0.01	<0.01	7.1	0.4	0	
	<i>Medicago</i>	0-2	0.01	<0.01	13.2	0.4	0	
	<i>Rosa</i>	0-2	0.01	<0.01	0.7	0	0	
	<i>Trifolium</i>	0-5	0.01	<0.01	13.5	0.9	0	
Erical	<i>Platanus</i>	100-300	5.6	0.16	13.5	2.3	1	+
Gentianal	Oleaceae	5-90	4.0	0.24	15.2	4.9	1.5	+
Lamiales	<i>Plantago</i>	20-160	7.8	0.44	36.1	2.6	0.4	+
Rubial	<i>Sambucus</i>	0-3	0.03	0.01	5.6	1.5	0	
Asteral	<i>Ambrosia</i>	0-5	0.01	<0.01	0	0	0	
	<i>Artemisia absinthium</i>	10-30	1.2	0.03	7.1	2	0.5	
	<i>Artemisia vulgaris</i>				9.4	3	1.5	+
	<i>Solidago</i>	1-5	0.6	0.01	6.4	2.3	1.5	+
	<i>Taraxacum</i>				7.5	1.5	0.7	+
	<i>Chrysanthemum</i>				8.6	2.3	1.5	+

* Includes grass and cereal pollens.

† Includes Japan and white mulberries.

A: total results, B: percentage of patients having a positive skin test to the given pollen species and no positive skin test to grass pollens, C: percentage of patients having a single pollen allergy. RAST+ designates these antigens used in tests for IgE.

nasal or bronchial challenge was made. Finally, for some unexplained sensitivities nasal or bronchial challenges were also done.

In all cases, clinical symptoms were compared to the *in vivo* and *in vitro* tests.

Results

Pollen calendars

The number of taxons recovered in the Montpellier atmosphere every year ranges from 169 to 178 and the total number of pollen grains/m³ of air (annual mean) varies from 125 to 135.

A list of the main pollinating plants is presented in Table 2 and Fig. 1. In terms of grains/m³ of air, taken in order, Cupressaceae pollens are most frequent and grass pollens (grass and cereal) next in frequency. The ratio of pollen grains of these major pollinating plants (Fig. 1) ranges from 1 to 10.

In terms of weight of pollens, taken in order, grass (grass and cereal) pollens rank first and Cupressaceae second. The decreasing order of major species is not very different from the order obtained when the results were expressed in grains/m³ of air, but the ratio ranges from 1 to 123.

Table 2. Rank order of the main pollinating plants of the Montpellier area according to the expression of the results

	Weight/m ³	Counts
Gramineae	1	2
Cupressaceae	2	1
Oak	3	3
Plantain	4	4
Plane tree	6	5
Oleaceae	5	6
Urticaceae	7	7
Moraceae	7	8
Compositae	9	9

The total results are expressed in Table 1. It is evident that many pollens are recovered in extremely low quantities and only represent less than 0.01% of the total annual count, i.e. <0.01 grain/m³ of air.

Pollinosis of the Mediterranean area

Pollen allergy was detected in 326 patients who were born and still lived in the Montpellier area. There was no discrepancy between prick tests and RAST except in four patients who were withdrawn from the study.

Among the pollen allergic patients (Table 1), 86.5% were sensitized to grass pollens which, in order, ranked first. Plantain pollinosis (36.1%), Parietaria (27.1%),

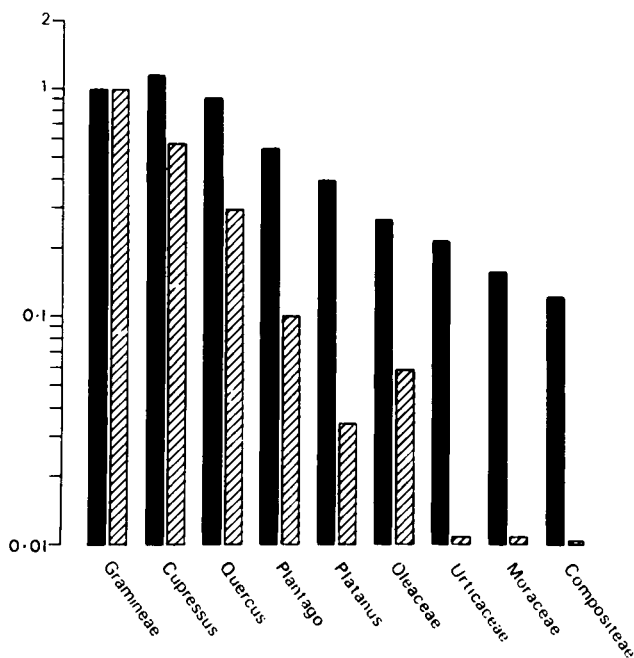


Fig. 1. Comparison of the pollen rain of the main pollinating plants expressed in weights of pollens (▨) or in absolute numbers (■). A ratio of 1 was attributed to grass pollens (including grass and cereals).

Cupressaceae, London plane and Oleaceae sensitivities (13.5–15.2%) were also important and the incidence of positive tests was associated with the occurrence of airborne pollens. In contrast, positive skin tests were recorded to alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*) (13.5%), lime tree (*Tilia*) (6.8%), and acacia (*Acacia verek*) (7.1%) though little or no pollen was found in the air, the percentage of the total pollens being in the range of 0–0.01%. However, at least for a limited number of patients, there was evidence of a local source of pollen, as for six patients who had a lime tree in their garden and showed symptoms during its flowering season. This also applied to two patients who had symptoms when cutting their fields of red clover or alfalfa. In all cases, the diagnosis was confirmed by a positive nasal provocation test. However, in the other cases, a true allergy could not be demonstrated.

A large amount of a particular pollen in the air is not always associated with allergy. Pine pollens formed 6.6% of the total pollen, but no case of allergy was detected, and oak formed 12.7% of the total pollen burden, but only 6.8% patients had IgE to oak pollen.

Since 86.5% of patients had specific IgE antibodies to grass pollens, most pollen-allergic patients were also sensitive to other pollens. In fact, only 29.7% of pollen-allergic patients were sensitive to grass pollens alone. In some few instances, patients were sensitive only to *Parietaria* pollens (2.2%), Cupressaceae, or London plane or Compositae pollens (1–1.5%), and, in some rare cases, patients were allergic only to Moraceae or plantain pollens (0.4–0.7%).

The results showed that *Parietaria* and nettle pollens, although belonging to the same family (Urticaceae) and very difficult to discriminate by microscopical analysis,

did not seem to have cross-reacting antigenic determinants since 71% of patients had positive skin tests to *Parietaria* alone, 16% to nettle alone and 13% to both *Parietaria* and nettle.

Discussion

Pollens have been counted by a method newly applied to studies of allergy although it has been used previously for geological and palynological research (Cour *et al.*, 1980; Van Campo, 1972) and adapted to the prediction of crop yields (Cour & Bousquet, 1981). The sampler is effective in obtaining counts of the various pollens and identifying them (Cour *et al.*, 1983). Moreover, the percentage of unidentified pollens is usually very low and under one. Finally the quantification of pollen grains is remarkably efficient since it is possible to predict the annual variations of crop yields by the variation in the number of pollen grains of a given species found in the atmosphere (Cour & Bousquet, 1981). In most instances pollen calendars are expressed in number of grains/unit. However since the size of pollen grains varies widely (Morrow Brown, 1973) it is therefore more accurate to express the results in weights of pollens inhaled. The weight of the various pollens was estimated according to the size (mean size) and shape of the pollens. For Gramineae pollens both grass and cereal pollens were taken into account since the size of the latter is larger. For Oleaceae pollens each species has a distinctive morphology and the total weight of Oleaceae pollens included all species. The annual weight of pollens inhaled was expressed in mg/3500 m³ of air since it was calculated by Fishman (1980) that the average volume of air inhaled yearly by a normal adult is likely to range from 3000–4000 m³ of air. This value is subject to large variations according to the subjects but it has the advantage of providing a simple and easily understood value of the amount of pollens inhaled. This estimation is, however, less precise than the number of pollen grains caught on the filter sampler. The weight of pollen grains inhaled should be corrected by the amount of allergenic proteins released by each pollen species but it appears that this estimation is, at present, impossible to determine for most pollen species. For ragweed pollens such measures are therefore possible (Marsh, 1975). It has been shown that there is no correlation between the protein content of an extract and the allergenic proteins (Arbesman & Eagle, 1939); Bousquet *et al.*, 1983; Brighton *et al.*, 1980). It was not therefore found desirable to balance the weight of pollen grains against the total protein content of each pollen species.

The examination of the pollen calendar of the Montpellier area showed that grass pollens are the major pollinating plants whether the pollens are expressed in percentage of total pollens caught in the filter sampler or in weight of pollens inhaled. It is clear that Cupressaceae pollens (cypress and juniper) are present in larger numbers of grains, but in slightly lower weights than grass pollens. On the other hand, some highly allergenic pollens are present in very low amounts especially when the weights of pollens are considered. There are ninety times more grass pollens than either Moraceae or Urticaceae pollens and 123 times more grass pollens than Compositeae pollens.

The allergic sensitivities of the patients were determined by modified prick tests performed in a standard manner (Menardo, Bousquet & Michel, 1982), and when possible by the correlation of skin tests with serum IgE specific antibodies. In fact, the allergens coupled on the RAST disc and used for skin tests were from different origin but only four patients showed large discrepancies between these two tests and were

withdrawn from the study. The extracts were expressed in weight by volume and not in allergen units. However, for most pollen extracts, the quality of the extracts appears to be appropriate. For pine and cypress pollens, however, the quality of the prick-test extracts may not be good enough since these pollens do not release large amounts of proteins. More concentrated extracts could be used, and the failure to detect any patient allergic to pine may be related to the weak concentration of the extract.

The major allergenic species of the Montpellier area is grass pollen, since 86.5% of pollen-allergic patients had positive skin tests and RAST to these pollens. It must be claimed that Bermuda grass (*Cynodon dactylon*) elicits a much weaker skin-test response than the other grass pollens tested by skin-test end-point titration (Bousquet *et al.*, 1983) and this finding correlated with the lower number of Bermuda grass plants found in the area. The importance of grass pollens in the region is certainly greater than in more southern parts of the Mediterranean where the counts are significantly lower (Cambon, 1982). The second allergenic pollen of the Montpellier area is plantain and this sensitivity can be explained by the large number of pollens found in the atmosphere. Plantain pollinosis is widespread and such sensitivity has been reported in many parts of the world (Wodehouse, 1971). Parietaria pollen allergy is the third in order of allergenicity. Parietaria pollen is a very potent allergen as measured by the prick-test end-point titration with serial 3-fold dilution extracts. The mean end point in thirty allergic patients is 3535^{-1} for cocksfoot pollens, 180^{-1} for Bermuda grass pollens and 6732^{-1} for Parietaria pollens (Bousquet, unpublished data). In Valencia, Spain, Parietaria appears to be the major allergenic pollen and a single Parietaria pollen sensitivity is often observed (Basomba, pers. comm.), whereas the sensitivity restricted to Parietaria pollens alone is only seen in 2.2% of pollen-allergic patients in Montpellier. The prevalence of Parietaria is much higher in Valencia and the ratio of Parietaria pollens between Montpellier and Valencia is 1/3. A group of pollens found especially in Mediterranean zones are allergenic in many patients, London plane, Olaceae and Cupressaceae pollens. The allergy to these pollens is well documented throughout the Mediterranean (Charpin *et al.*, 1960; Aubert *et al.*, 1959; Michel *et al.*, 1978b; Tas, 1965) and the results observed in the present study confirm previous data. Cypress pollinosis is often local: most affected patients live near cypress edges which are very common. It appears that the huge number of cypress pollens present in the atmosphere are not sufficient to elicit symptoms in many patients, and it is likely that rollers from local sources potentiate the stimulus.

Alfalfa, red clover, lime tree and acacia pollens were found to induce skin tests in 6.8–13.2% of patients. The size of the prick tests to these pollens was never greater than 8 mm in diameter whereas the size of the mixed grass pollen extract ranges from 4.5 to 25 mm in diameter. Moreover, the high rate of positive skin tests cannot be explained by the counts of pollens in the atmosphere nor by local conditions since acacia trees are not as common as many others and the mode of pollination of these trees and weeds is unlikely to give rise to many pollen grains in the atmosphere. Six patients were in close contact with lime trees during their pollination and were found to be allergic to lime-tree pollens by means of nasal provocation tests. Two patients were also allergic to alfalfa or red clover pollens since they experienced symptoms while cutting these weeds and, again nasal provocation tests were positive. However, the majority of patients with positive skin tests to these four pollens could not be considered to be allergic to them and the reactions may be due to cross-reactions as has been found between acacia and grass pollens (Howlett, Hill & Knox, 1982).

White and Japan mulberries are not rare in the Mediterranean landscape and some allergies are found to these pollens but in most cases, owing to the very low pollen concentration in the atmosphere, patients with such allergies live close to these trees. Chenopod, amaranth and beete pollens induce positive skin tests in 3.4–6.4% of pollen-allergic patients. The pollens are more prevalent in North Africa and by way of example in Oran, Algeria there are at least twenty times more chenopod pollens than in either Valencia or Montpellier (Cambon, 1982).

Finally, several tree pollen sensitivities not restricted to the Mediterranean area are present in less than 10% of patients: alder, birch, hornbeam, chestnut, oak, elm, maple, willow, and elder. For some species such as oak, the number of patients who had specific IgE antibodies was very low in comparison to the quantities of pollens present in the atmosphere. On the other hand, for chestnut, the number of patients presenting positive skin tests is relatively high since there are almost no chestnut trees in Montpellier. For these tree pollens there is no doubt that many positive skin tests seldom indicate true sensitivities and many others are probably due to cross-sensitivities (Bernstein *et al.*, 1976).

In the Northern part of the Mediterranean zone it appears that the degree of pollinosis is intermediate between that of non-Mediterranean zones and that of the southern Mediterranean areas. Grass pollens are the major pollinators and they are also the major allergenic pollens. Plantain pollens which are widespread throughout the world are the second major allergenic pollens. Parietaria, cypress and juniper, Oleaceae and London plane are important but their sensitivity alone is rare. These findings are close to other data previously presented by Mallea *et al.* (1980) for Nice, another city in the south of France.

Acknowledgments

The authors thank Dr H. Dhivert, C. Seignalet, J.P. Marty, J. Gastambide and Mrs Cambon and Duzert for their help.

References

- ARBESMAN, C.E. & EAGLE, H. (1939) The assay of ragweed pollen extracts. *Journal of Allergy*, **10**, 521.
- AUBERT, J., CHARPIN, H. & CHARPIN, J. (1959) Etude palynologique de quelques Olanées de Provence. *Pollen et Spores*, **1**, 7.
- BERNSTEIN, I.L., PERERA, M., GALLACHER, J., MICHAEL, J.G. & JOHANSSON, S.G.O. (1976) *In vitro* cross-allergenicity of major aeroallergenic pollens by the radio allerge sorbent technique. *Journal of Allergy and Clinical Immunology*, **57**, 141.
- BOUSQUET, J., GUERIN, B., FURIC, R. & MICHEL, F.B. (1983) Standardization of allergenic extracts. In: *Provocative Testing* (Ed. by S. Spector) CRC Press, Boston, p. 145.
- BRIGHTON, W.D. (1980) Introduction on possibilities and limitations of potency determination. In: *Regulatory Control and Standardization of Allergic Extracts*, (Ed. by H.D. Brede and H. Going) p. 111. Gustav Fisher Verlag, Stuttgart.
- CAMBON, G. (1982) *Relations entre le contenu pollinique de l'atmosphère et le couvert végétal en Méditerranée Occidentale, à Montpellier (France), Valencia (Espagne) et Oran (Algérie)*. Vegetal Biology Thesis, Montpellier.
- CENTANNI, G., RIVOCSECCI, V. & BUSINCO, L. (1959) Allergènes et maladies allergiques en Italie. *Acta Allergologica*, **14**, 289.
- CHARPIN, J., AUBERT, J. & CHARPIN, H. (1962) *La Pollinose*, Expansion Scientifique Française, Paris.
- CHARPIN, H., AUBERT, J. & CHARPIN, J. (1965) Recensement quotidien des grains de pollens de Chenopodiacees, Amaranthacees et d'Artemisia dans l'atmosphère de Marseille en 1955. *Comptes Rendus de l'Académie des Sciences, Paris*, **247/2**, 1492.

- CHARPIN, J., AUBERT, J., SIMON, L. & COSTE, J. (1960) Allergie respiratoire pollinique dans le Sud-Est de la France. *Presse Médicale*, **68**, 2175.
- CHARPIN, J. & CHARPIN, H. (1980) *Parietaria officinalis* allergy. *Journal of Allergy and Clinical Immunology*, **65**, 80.
- CHARPIN, J., SURINYACH, R. & FRANKLAND, A.W. (1974) *Atlas of European Allergenic Pollens*. Sandoz, Paris.
- COUR, P. (1974) Nouvelles techniques de détection des flux et retombées polliniques; étude de la sédimentation des pollens et des spores à la surface du sol. *Pollens et Spores*, **16**, 103.
- COUR, P. & BOUSQUET, J. (1981) Crop prediction using pollen counts. *Span*, **24**, 83.
- COUR, P., BOUSQUET, J., NILSSON, S., DUZER, D. & MICHEL, F.B. (1984) Pollen sampling using a filter trap with computerization of data. Description and efficacy of the trap. *Journal of Allergy and Clinical Immunology*, (in press).
- COUR, P., SEIGNALET, C., GUERIN, B., MAYRAND, L. & MICHEL, F.B. (1980) Interregional studies of pollen incidence from Lapland to North Africa. *Proceedings of the 1st International Conference on Aerobiology, Munich*, Schmidt Verlag, p. 61.
- DURHAM, O.C. (1946) The volumetric incidence of airborne allergens. IV. A proposed standard method of gravity sampling, counting and volumetric interpolation of results. *Journal of Allergy*, **17**, 79.
- FISHMAN, A.P. (1980) *Pulmonary Diseases and Disorders, Vol. 1* McGraw-Hill Book Co., New York.
- HEWITT, B., BOUSQUET, J., GUERIN, B. & MICHEL, F.B. (1983) Cross reactivity among Urticaceae pollens. *Journal of Allergy and Clinical Immunology*, **71**, 105.
- HIRST, J.M. (1952) An automatic volumetric spore trap. *Annals of Applied Biology*, **39**, 257.
- HOWLETT, B.J., HILL, D.J. & KNOX, R.B. (1982) Cross reactivity between Acacia (wattle) and grass pollen allergens. *Clinical Allergy*, **12**, 259.
- LIEBESKIND, A. (1960) Pollinosis in Northern Israel. *Annals of Allergy*, **18**, 663.
- LIEFERMAN, K.M. & GLEICH, G.J. (1975) Cross-reactivity of IgE antibodies with pollen allergens. I. Analysis of various species of grass pollens by the radio allergo sorbent technique. *Journal of Allergy and Clinical Immunology*, **58**, 129.
- LINDENBAUM, S.E. (1966) Pollinosis due to Amaranthaceae-Chenopodiaceae in Israel. *Israel Journal of Medical Science*, **2**, 546.
- MALLEA, A., SOLER, M., KARA, A., REBOUL, A.R. & CHARPIN, J. (1980) The pollen calendar of Nice and pollinosis. *Proceedings of the 1st International Conference on Aerobiology, Munich, 13-15 August 1978*, Erich Schmidt Verlag, Berlin, p. 50.
- MARSH, D.G. (1975) Allergens and the genetics of allergy. In: *The Antigens*, (Ed. by M. Sela) Academic Press, New York, p. 271.
- MENARDO, J.L., BOUSQUET, J. & MICHEL, F.B. (1982) Standardization of skin tests. *Proceedings of the Annual meeting of the European Academy of Allergy and Clinical Immunology, Clermont-Ferrand, September 1981*, 1018.
- MICHEL, F.B., COUR, P., QUET, L. & MARTY, J.P. (1976) Qualitative and quantitative comparison of pollen calendars for plain and mountain areas. *Clinical Allergy*, **6**, 383.
- MICHEL, F.B., DHIVER, H., MARTY, J.P., COUR, P., ALQUIE, M.C. & GUERIN, B. (1978a) Pollinoses hivernales. *Revue française d'Allergologie*, **18**, 83.
- MICHEL, F.B., MARTY, J.P., COUR, P. & LE BROZEC, J. (1978b) Pollens testés et non testés. *Revue française d'Allergologie*, **18**, 71.
- MORROW BROWN, H. & IRVING, K.R. (1973) The size and weight of common allergenic pollens. *Acta Allergologica*, **28**, 132.
- SERAFINI, U. (1957) Studies on hay-fever. *Acta Allergologica*, **11**, 3.
- SOLOMON, W.R. & MATHEWS, K.P. (1978) Aerobiology and inhalant allergens. In: *Allergy, Principles and Practice*. (Ed. by E.J. Middleton Jr, C.E. Reed and E.F. Ellis) Mosby Co, St Louis, p. 899.
- SURINYACH, R. (1960) Observations on some pollen Aerobiological standards in North-East Spain. *Acta Allergologica*, **7**, 151.
- TAS, J. (1965) Hay fever due to the pollen of *Cupressus sempervirens* (Italian or Mediterranean). *Acta Allergologica*, **20**, 405.
- VAN CAMPO, M. (1975) Analysis in the Sahara. In: *Problems of Prehistory: North Africa and Levant*. (Ed. by F. Wendorf and E. Marks) Southern Methodist University Press, Dallas, p. 45.
- WODEHOUSE, R.P. (1971) *Hay Fever Plants*, 2nd ed. Hafner Publishing Co. New York.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.