

Parameters of ragweed pollination in the Lyon's area (France) from 14 years of pollen counts

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Abstract

This study analyzes the pollen counts obtained from the air of the greater Lyon (corresponding to the urban area of Lyon) an area which has been overrun by ragweed in the last 40 years. Two periods are investigated, 1982–1989 and 1990–1995. The year 1995 deserves specific attention because for the first time a campaign of ragweed eradication was launched in greater Lyon. From the data of the 14 pollination seasons it was possible to define some parameters: subpathological risk period, pathological risk period and the position and level of the pollen peak. Our study indicates the progression of the weed in the infested area over the two periods. In 1995 a slight decrease in the pollen count was observed but this was followed by a second peak probably related to later growth of some plants which had been cut. In this connection, 4 weeks weeding campaign is not long enough and in the future a 6-week campaign without the use of weedkillers should be planned. Determining the parameters of ragweed pollination every year will be useful both to patients and physicians concerned by allergy to ragweed pollen. According to the level of the ragweed pollen in the air, the patients may take appropriate medication. This study emphasizes the necessity to record air pollen concentrations over many years. In particular, the actual impact of cutting ragweed before pollination on ragweed pollen counts can only be evaluated after several years of eradication. © 1997 Published by Elsevier Science Ireland Ltd.

Keywords: Ragweed; *Ambrosia artemisiifolia* L.; Pollen counts; Pollen traps; Aerobiology; Allergy

1. Introduction

In addition to various chemical polluting agents the air also carries biological materials which can be health threatening. This is the case for many pollen types from grasses, trees or weeds, which cause symptoms of allergy among the sensitized populations. Determining the amount of each pollen type in the air is a mean for evaluating such a risk. Pollen counts are obtained by sampling air from the atmosphere with different pollen traps and then by identifying and counting the pollen types of interest (Cour, 1974).

Pollen counts are useful in at least two instances. In the short run, pollen counts help patients and physicians to adapt the medication to the level of the offending pollen in the air. In the long-term, pollen counts are the most convenient way to evaluate the spreading or the decrease of the plant in question.

For both purposes it would be useful to define the parameters of pollination for a given plant by using the same trap located in the same place. The purpose of this study is to define some significative parameters for ragweed pollination, by analyzing 14 years of data on ragweed pollen counts in the Lyon area with the Cour's trap (Cour, 1974). These parameters were used to compare ragweed pollination during two periods, 1982–1989 and 1990–1995, and to tentatively evaluate the first eradication campaign undertaken in 1995. The first

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period has been previously analyzed (Dechamp and Dechamp, 1992).

2. Materials and methods

2.1. Place of the study

Greater Lyon, a city of about one million inhabitants, is located 168 meters above sea level at 45°42' North latitude and 4°54' East longitude. Lyon has a subtle mixture of oceanic, continental and mediterranean climates (Blanchet, 1993; Dechamp, 1992).

2.2. Pollen trap

The Cour's trap is located at the Lyon-Bron meteorological station on the eastern outskirts of Lyon. It is a semi-urbanized place with fairly low, widely-spaced dwellings. The filter of the trap is set 3 m above a well-kept meadow. The results of pollen counts are expressed as the number of pollen grains/m³ of air collected during 1 week. The weekly data were recorded over 14 years by AFEDA, the French Association for Ragweed Study (AFEDA, 1985–1995, Dechamp, 1995). Weeks are identified by their rank in the year (i.e. week 36 corresponds to the first week of September). Student's *t*-test is used for the comparison of pollen peak means and annual cumulative pollen counts. Differences are significant when $P < 0.05$.

3. Results and discussion

From the analysis of the data from 14 years of ragweed pollen counts presented in Table 1, it is possible to define the following parameters.

3.1. Threshold $S_{0.1}$ and the first part of the pollination period

After Comtois and Sherknies, 1987 and a previous study from our group (Dechamp and Dechamp, 1992), this period can be called the *subpathological risk period*. This period begins the week the threshold $S_{0.1}$ (0.1 grain/m³) is reached provided that the count measured the following week is greater. Allowing for exceptions, no patients sensitized to ragweed are ill at this time. From 1982 to 1989 (Table 2) $S_{0.1}$ was reached five times during weeks 30 or 31 (end of July–beginning of August). From 1990 to 1994 $S_{0.1}$ was reached 3 times during weeks 30 or 31. In 1995 $S_{0.1}$ took place on week 30.

3.2. The threshold S_5 and the second part of the pollination period

The definition of threshold S_5 is the first week the count reaches 5 grains/m³. By this time the more sensitive patients to the pollen begin to be affected. We called the period where the weekly pollen counts remain over the threshold S_5 the *pathological risk period*. It probably fits in with the flowering period defined by Comtois and Sherknies (1987).

From 1982 to 1989 (Table 3) in all instances but one, this threshold was reached seven times during weeks 33 or 34 (middle and middle-end of August). From 1990 to 1995 this occurred twice during week 33 and four times during weeks 31 or 32. Threshold S_5 seems to be reached earlier during the second period.

3.3. The position of the pollen peak

The position of the *pollen peak*, that is the week the maximum value of pollen grains in the air is recorded, is a very important set of data for physicians and their patients. During the 1982–1989 (Table 4), a 3-week-interval, between the threshold S_5 and the peak, was observed in all the instances. During the 1990–1995, the 3 week-interval occurred only twice and on three occasions the interval was longer. The data for 1993 were not interpretable because of very heavy rainfalls during the period of active pollination. Unless very special meteorological conditions apply, it is possible to forecast the fortnight the pollen peak will occur, after the week the threshold S_5 is reached. During the second period the interval between the threshold S_5 and the peak of pollination tends to become longer.

3.4. The level of the pollen peak

The values for the *maximum weekly pollen count* recorded each year (pollen peak) were higher during the 1990–1995 period than during the 1982–1989 period (Table 5). The means are significantly different (186.5 ± 61.8 grains/m³ first period versus 428.0 ± 50.8 grains/m³ second period; $P = 0.019$). In this context, 1983 appears to be an exception which may be explained by the presence near the pollen trap of a building site highly infested by ragweed. The top value for a pollen peak was recorded in 1995.

3.5. The annual cumulative pollen count

The *annual cumulative pollen count* is (Fig. 1) the sum of the weekly counts from week 31 to week 43. The mean of *annual cumulative pollen counts* is significantly higher for the 1990–1995 period than for the 1982–1989 period (43.3 ± 18.4 grains/m³ first period versus 73.0 ± 21.7 grains/m³ second period; $P = 0.017$). For

Table 1
Weekly pollen counts for the weeks 26–43 for period 1 (1982–1989) and period 2 (1990–1995)

First period 1982–1989								
Week	1982	1983	1984	1985	1986	1987	1988	1989
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
27	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.18
28	0.00	0.13	0.00	0.00	0.00	0.38	0.14	0.00
29	0.00	0.00	0.84	0.10	0.08	0.00	0.41	0.48
30	0.04	0.30	0.00	0.09	0.39	0.00	0.43	2.31
31	0.10	0.57	0.11	1.11	1.10	0.05	1.90	2.01
32	0.67	0.08	0.18	0.22	2.80	0.17	17.90	4.07
33	9.78	0.23	0.20	3.61	20.06	3.31	163.64	67.06
34	43.07	27.56	13.01	12.36	74.30	42.20	140.79	42.19
35	70.88	87.17	76.29	72.52	67.95	104.39	218.49	44.37
36	112.72	227.72	77.61	31.66	161.27	90.33	151.40	116.08
37	40.16	457.40	175.48	125.71	163.34	101.98	21.64	96.11
38	12.41	187.06	57.20	46.76	116.23	118.73	15.88	61.07
39	12.23	32.98	12.77	37.25	6.23	26.64	7.31	8.95
40	0.34	3.44	11.19	7.78	7.68	4.80	12.89	2.65
41	0.23	11.10	3.18	30.89	1.95	0.69	0.55	1.37
42	0.92	7.33	0.04	1.29	0.96	8.30	1.44	10.03
43	0.07	0.32	9.80	2.56	1.68	0.78	2.14	6.51
Second period 1990–1995								
Week	1990	1991	1992	1993	1994	1995		
26	0.00	0.00	0.05	0.00	0.00	0.00		
27	0.29	0.00	0.00	0.29	0.00	0.00		
28	0.40	0.00	0.04	0.00	0.00	0.00		
29	0.27	0.00	0.00	0.82	0.52	0.00		
30	0.36	0.10	1.38	3.47	4.13	0.15		
31	0.46	0.60	9.84	8.52	7.54	1.08		
32	30.47	2.56	18.00	40.65	22.11	3.38		
33	13.15	7.61	12.51	216.69	101.26	17.34		
34	82.76	193.70	16.23	29.92	168.97	116.36		
35	339.60	171.17	363.47	39.18	211.77	58.75		
36	86.77	107.72	138.09	201.02	661.36	735.54		
37	98.97	250.11	130.29	121.44	125.09	213.71		
38	32.03	65.13	66.38	39.89	49.87	41.18		
39	31.76	20.67	48.46	4.55	10.10	7.80		
40	5.56	3.27	1.23	2.60	1.20	39.25		
41	6.43	1.33	0.42	3.66	3.82	3.71		
42	4.33	1.81	0.26	1.28	5.72	0.69		
43	2.06	0.22	0.92	0.34	1.39	3.09		

Counts are expressed as the number of ragweed pollen grains in 1 m³ of air.

1994 and 1995 it is in the same range. The increase of annual cumulative pollen counts during the 14 years is also demonstrated by simple regression analysis (Fig. 2) which shows a positive correlation ($r = 0.66$, $P = 0.010$). The annual cumulative pollen count is not always correlated to the level of the pollen peak. For example, in 1993 there was 2 weeks of heavy rainfall that occurred right in the middle of the pollination period that produced a dramatic decrease in the annual cumulative pollen count.

3.6. The length of the second part of the pollination period

It is defined as the number of weeks exceeding the threshold S_5 and it corresponds to a period of pathological risk for the patients (Table 6). It lasted 7 or 8 weeks six times out of eight during the 1982–1989 (mean $\pm$ SD: 8 ± 0.756). It was longer although not statistically different (mean $\pm$ SD: 8.67 ± 1.033 $P = 0.187$) in 1990–1995 lasting 9 or 10 weeks four times

Table 2

Position of the week which reaches the threshold $S_{0.1}$ (week $S_{0.1}$) with increasing count the following week

First period 1982–1989								
Year	82	83	84	85	86	87	88	89
Week $S_{0.1}$	31	30	31	31	30	32	28	29
Second period 1990–1995								
Year	90	91	92	93	94	95		
Week $S_{0.1}$	27	31	30	29	29	30		

The threshold $S_{0.1}$ corresponds to a weekly pollen count equal to 0.1 grain/m³

out of six. In 1995, the weekly counts were over the threshold S_5 for 8 weeks.

4. Conclusions

This study underlines the necessity for measuring the pollen grain concentration in the atmosphere over a long period of time in order to define some parameters of the pollination. Many variable factors may affect the presence of the pollen grains in the air and it is of paramount importance not to vary these factors whenever possible. This is the case for the methodology concerning the collection (type and place of the trap) and the identification of the pollen grains. As exemplified by the pollen counts for the year 1993, the recording of climatic conditions and of all unusual meteorological events is also required. In these conditions, the variation of the concentration of pollen grains in the air can be related to the variation of the weed population in the corresponding area.

Parameters of the ragweed pollination in the Lyon area can be established from the analysis of 14 years of ragweed pollen count records. Considering two thresholds, the subpathological risk period, the pathological risk period, the position and level of the pollen peak and length of the pathological risk period can be defined. From the position of the threshold S_5 it is

Table 3

Position of the first week which reaches the threshold S_5 (week S_5)

First period 1982–1989								
Year	82	83	84	85	86	87	88	89
Week S_5	33	34	34	34	33	34	32	33
Second period 1990–1995								
Year	90	91	92	93	94	95		
Week S_5	32	33	31	31	31	33		

The threshold S_5 corresponds to a weekly pollen count equal to 5 grains/m³.

Table 4

Position of the week of the maximum pollen count (week max = week of the peak) and number of weeks between the week of the peak and the week of the threshold S_5 (Week max – Week S_5)

First period 1982–1989								
Year	82	83	84	85	86	87	88	89
Week max	36	37	37	37	36–7	37–8	35	36
Week max – Week S_5	3	3	3	3	3	3	3	3
Second period 1990–1995								
Year	90	91	92	93	94	95		
Week max	35	37	35	ni*	36	36		
Week max – Week S_5	3	4	4	ni*	5	3		

possible to forecast the fortnight of the pollen peak which occurs, in the majority of cases, 3 or 4 weeks after. This provides useful information for patients sensitized to ragweed, who can try to leave the infested area for the period of the pollen peak.

By using these parameters and comparing the two periods, demonstrates that the pollution of the air by the ragweed pollen grains has increased in the greater Lyon area. The first argument is the significant increase of the annual cumulative pollen counts as indicated by comparison of the means and positive correlation. Secondly, the pathological risk period was longer and the maximum peak was significantly higher during the second period as compared to the first. This is related to an expansion of the weed in the area around the trap. Until recently, ragweed thrived mostly on untended lands but now it is spreading even on cultivated soils, especially in sunflower and pea fields. For example, the sunflower cultivation in the Rhône district covered 2000 hectares in 1988, 4000 ha in 1991 and 5100 ha in 1993 (Agreste, 1993). Since 1994, the Common Agricultural Policy which instituted the set-aside system probably contributes to the expansion of ragweed during the second period. In the Rhône district set-aside covered 1800 ha in 1988 and was extended to 5100 ha in 1993.

Table 5

Number of ragweed pollen grains/m³ during the week of the maximum pollen counts (N max)

First period 1982–1989								
Year	82	83	84	85	86	87	88	89
N max	113	457	175	126	168	119	218	116
Second period 1990–1995								
Year	90	91	92	93	94	95		
N max	340	250	364	217	661	736		

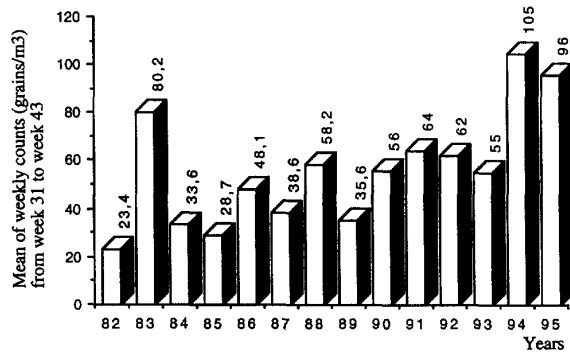


Fig. 1. Annual means of the weekly counts (ragweed grains/m³) for the years 1982–1995. The mean for each year is indicated at the top of the corresponding column.

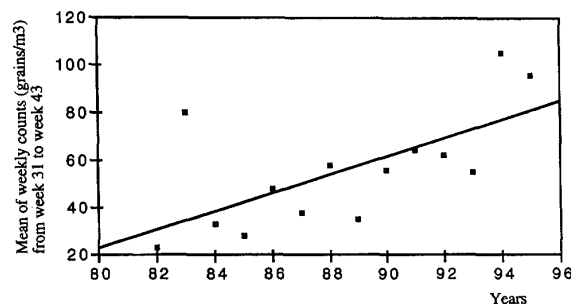


Fig. 2. Regression analysis of annual means of the weekly counts (ragweed grains/m³) during the period 1982–1995. The data are the same as in Fig. 1.

In 1995, a decrease of ragweed pollen grains in the air was observed. However, 1 year is not long enough to confidently attribute the decrease to the eradication campaign. A more certain effect of the campaign was represented by a second late peak of pollen, that was never observed before. This indicates that the 4 week campaign was probably insufficient. A 6-week campaign may avoid later growth and the undesirable second peak.

Table 6

Number of weeks which exceed the threshold S_5

First period 1982–1989								
Year	82	83	84	85	86	87	88	89
Number of weeks	7	8	8	8	8	7	9	9
Second period 1990–1995								
Year	90	91	92	93	94	95		
Number of weeks	10	7	9	9	9	8		

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