

Ragweed pollen: The aeroallergen is spreading in Italy

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Abstract

Presently in Europe, ragweed pollen as an aeroallergen is not as important as Poaceae, *Parietaria* or Betulaceae, even if in some countries the plant is beginning to influence the local composition of the airborne pollen spectra. In northern Italy, the presence of ragweed airborne pollen has only been reported since the beginning of the 1980's and it is increasingly spreading from year to year. Given this situation, the allergologists have begun to regard the potential risk of sensitisation to ragweed pollen with much attention. Up to now, such pollen has not been included in the routine allergological tests. In 1995 in some sites of northern Italy (Turin, Milan, Trieste), the concentration values of ragweed pollen were remarkable ($\sim 20\text{--}30 \text{ p/m}^3$) and on the increase with respect to the previous years. This investigation aims at focusing the atmospheric concentration trend on this new aeroallergen (*Ambrosia* sp.) in Italy from 1991 throughout 1995. © 1998 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

The genus *Ambrosia* belongs to the Compositae family, which is composed of ~ 35 species, all originating from America except for two species, one coming from Arabia and the other autochthonous of the Mediterranean region: *Ambrosia maritima*.

In Europe, ragweed is considered as recently naturalised and its increasing presence is due to the feature of it being a pioneering plant with great adaptability to hostile habitats (in absence of interspecific competition). Ragweed is most frequently associated with agriculture and is found in cultivated fields (mainly maize, sunflower, leguminous plants). It also occurs on disturbed soils, wastelands, roadsides and along the railways, along irrigation canals, on riverbanks and in building yards. It grows best on sandy and pebbly soils and adapts to a wide range of pH. At the first stages of development the plant grows slowly, speeding up at the

flowering stage and reaching maturity towards mid-August with pollen emission lasting little longer than 1 month. Ragweed is anemophilous, contrary to most Compositae. One plant alone produces many millions of pollen grains, which for their small size ($22\text{--}25 \mu\text{m}$), travel long distances. Man is considered the main cause for ragweed spreading from America to Europe, where first evidence of its presence was recorded in 1860 in Germany (Touraine et al., 1966). Presently five species of ragweed occur in Italy:

- *Ambrosia maritima* L.: Areas of the Mediterranean basin. It grows on sandy soils close to the seashore.
- *Ambrosia artemisiifolia* L.: North American areas. It is locally naturalised, mainly in Central and South Europe.
- *Ambrosia tenuifolia* Spreng: South American areas. It is naturalised in Southern France and in North-east Spain.
- *Ambrosia coronopifolia* (*A. psilostachya*) Torr. et Gray: North American areas, locally naturalised in Northern Italy.
- *Ambrosia trifida* L.: North American areas, locally naturalised in Northern Italy.

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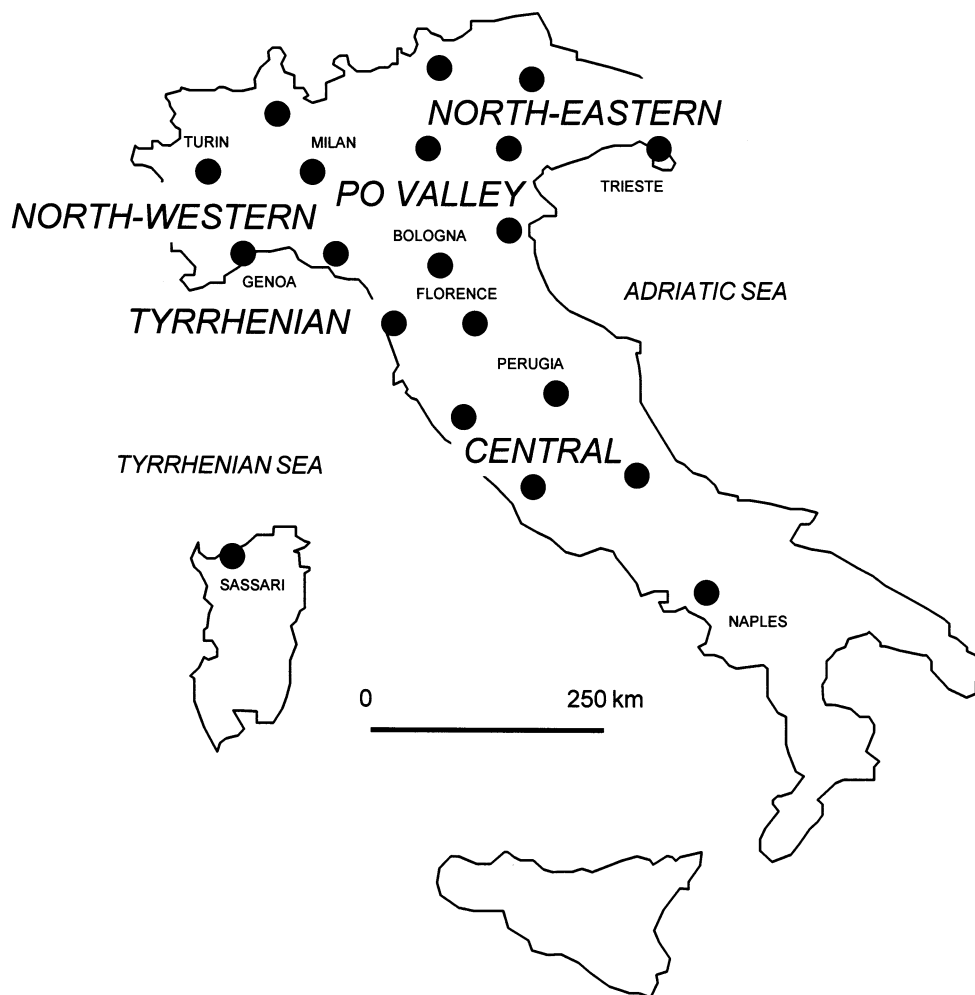


Fig. 1. The Italian peninsula has been subdivided into five areas to facilitate the graphical representation of ragweed distribution, namely: north-western, north-eastern, Po Valley, Tyrrhenian, Central. The black dots represent the 20 sampling sites considered in this paper and joining the Italian Aeroallergen Network.

In Italy, the summer–autumn pollinosis are mainly due to *Ambrosia artemisiifolia* (*Ambrosia elatior*) and to *Ambrosia trifida*, whereas *Ambrosia tenuifolia* and *Ambrosia coronopifolia* have a comparatively limited distribution.

2. The distribution of ragweed in Europe

In Europe, the knowledge about the distribution of ragweed is strictly linked to the attention that botanists and allergologists pay to this plant. Recently, through the aerobiological monitoring carried out extensively in many European countries, the knowledge about the presence of ragweed has been given a new and substantial boost (Jäger and Mandrioli, 1993). The greatest research activity about the presence of ragweed in Europe has been carried out in France by Chantal Déchamp (1995), who in 1983 founded the Association Française d'études des Ambrosies. In France, the

spread of ragweed has become significant since the post war years in 1950. Presently, the areas in which the plant has been detected are the Central, Lyonnaise and south eastern regions.

The pollen emitted per season is on average, 1/40 of that emitted by the Poaceae; however, in the mentioned regions (in the Lyonnaise area above all), its allergological impact is noticeable.

Ragweed is present also in Yugoslavia, Hungary, Czechoslovakia, Poland, Austria and Italy. In Switzerland, ragweed has been detected thanks to the aerobiological monitoring which has been carried out in Basel (Leuschner et al., 1983) since 1969. The wide spread of ragweed in Central and East European countries has been probably favoured by cereal imports from the United States and Canada where it is frequently found as a seed pest. In such countries, the plant is often found in large amounts as a weed on the edges of cultivated fields. Since 1972 ragweed has been detected in Yugoslavia, namely in Zagreb. In Szeged, Hungary

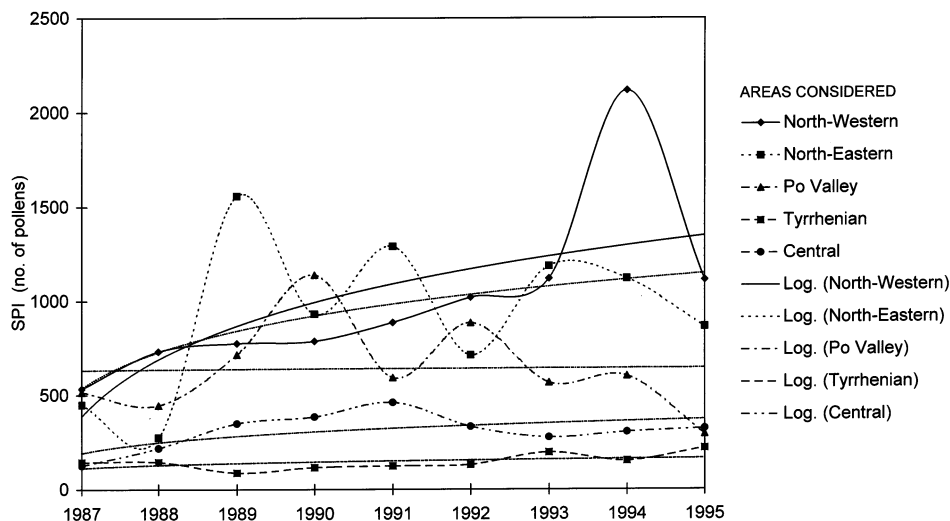


Fig. 2. Summation values of the daily concentration of Compositae pollen expressed as seasonal pollen index (SPI). On the same graph the logarithmic regression curves for the five areas investigated are shown. This figure enables us to evaluate the trend of the Compositae over a longer period of time (1987–1995).

(Jarai-Komlòdi, 1991; Kadoksa et al., 1991; Jarai-Komlòdi and Jushasz, 1993), concentrations of 300 p/m^3 are reached and the season lasts until end September. In Budapest, concentrations are lower (40 p/m^3). In Vienna, Austria ragweed is the fourth most important pollen from an allergological point of view; it was detected for the first time in the late 1970's and most of it comes with favourable wind from the Hungarian plains located south-east to the city (Jäger, 1990).

In Poland, through aerobiological monitoring (Obtulowicz et al., 1995) ragweed pollen in low concentrations (some pollen grains per m^3) has been recorded in Krakov, where 50% of pollinotics show sensitization to it. Thanks to the Czech and Slovak Pollen Information Service (Rybníček, 1995), very high concentrations of ragweed are recorded in Brno and Bratislava, with peaks at the end of August and by mid-September ranging from 800 to 1000 p/m^3 . Like Vienna, ragweed is the fourth most important pollen from an allergological point of view.

3. The distribution of ragweed in Italy

Presently in Italy, two main areas where ragweed presence is highest should be considered: The north-western area (Piedmont, close to Turin, and Lombardy, close to Varese) and the north-eastern area (Veneto and Friuli-Venezia Giulia, around Trieste) (Fig. 1). As early as 1902 in Northern Italy, namely in Piedmont and Liguria, thanks to vegetational investigations, *Ambrosia artemisiifolia* together with *Ambrosia annua* have been recorded as dominant among the vegetation of fallow land. Since 1981, the aerobio-

logical monitoring (Caramiello et al., 1990) has enabled to better understand the distribution trend of the plant. In Trieste, *Ambrosia sp.* was first recorded in 1982 by means of aerobiological monitoring (Pizzulin Sauli et al., 1992). The relevant pollen source was detected among the vegetation growing in the suburbs north-west to the city. In the following years, ragweed was recorded all over the province of Trieste. Also in this case, like in Vienna, the great quantity of ragweed pollen often monitored is carried by the prevailing winds, as the Sirocco (SE) and Bora (E-NE), and originates from plant colonies growing along the banks of the newly built highway running through the suburbs of the city and probably also from distant sources located in Yugoslavia. In Ferrara, a town located in the Po Valley, *Ambrosia tenuifolia* has been detected all over the territory, on the beach, close to the shoreline, behind the coastal dunes and as a weed in the sandy wastelands; its frequency decreases from north to south, perhaps due to the competition with *Ambrosia coronopifolia*, which is present along the whole coast-line and in the ruderal areas of the villages. Its frequency increases from north to south. As far as *Ambrosia maritima* is concerned, it has seemingly disappeared recently, maybe owing to the competition with the other American species, growing in similar habitats. At Gallarate, located north-west to Milan, the presence of *Ambrosia artemisiifolia* is confirmed both by aerobiological and clinical data and by its close proximity to the town, with a progressive spread toward the south (Albasser, 1992). At the Malpensa Airport, a few kilometers away, the plant is frequently found. At Brianza, located in the Milan province, ragweed pollen was first recorded in 1988, even if the plant was identified as early as 1982 (Piazza et al., 1992).

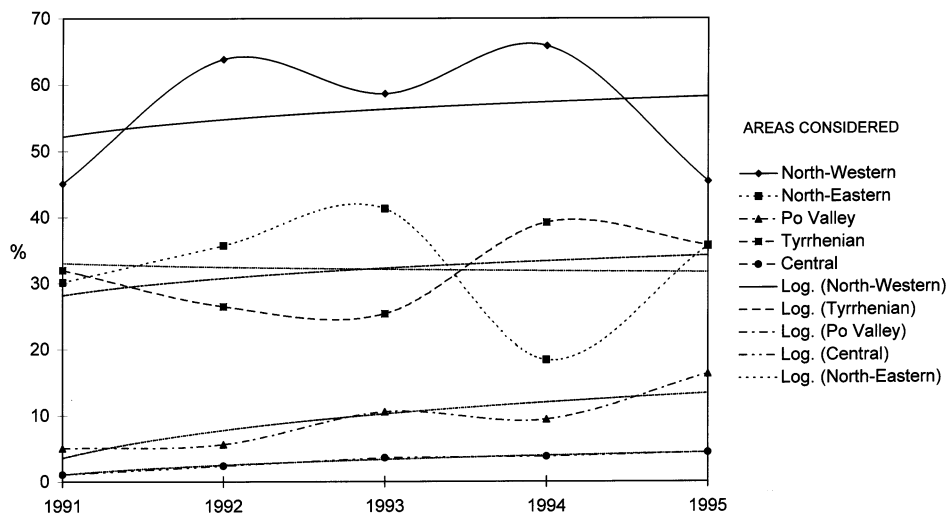


Fig. 3. Percentage of *Ambrosia* with respect to total Compositae during the period 1991–1995. On the same graph, the logarithmic regression curves for the five areas investigated are shown.

4. Materials and methods

The airborne pollen concentration data of 20 sampling sites joining to the Italian Aeroallergen Network (Mandrioli, 1990) have been considered. All sampling sites have employed the Hirst pollen trap. The sampling sites (Fig. 1) have been chosen following two criteria: their geographical location and the availability of continuous pollen data records. In this way, information on the Compositae pollen distribution has been obtained at a national level also in the sites where the vegetational investigations had never been conducted before. The distribution area of ragweed pollen stretches beyond the zones closest to the Alps, towards the southern fringe of the Po Valley and further in

Tuscany and Umbria (Perugia). Ragweed pollen has also been detected, even if in very low concentration, in Sassari, Sardinia. The Italian peninsula has been subdivided into five areas to easily represent ragweed distribution (Fig. 1), namely: north-western, north-eastern, Po Valley, Tyrrhenian, Central.

The pollen measurements of the Compositae taken into account, refer to the years 1987–1995 and those of *Ambrosia* *sp.* alone refer to the years 1991–1995. They are expressed as daily mean concentration value (p/m^3 of air) and as seasonal pollen index (SPI, summation of the daily mean concentrations during the main pollen season). The SPI is dimensionless.

Only sampling sites with data records in which pollen concentration of *Ambrosia* *sp.* has been at least once

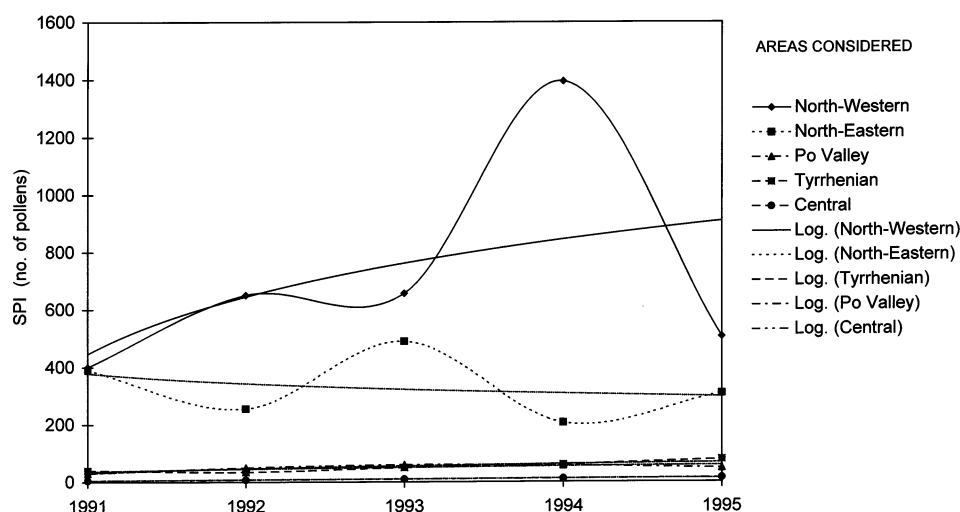


Fig. 4. Two areas show the highest *Ambrosia* SPI values, as compared to the others, namely the north-western one (Piedmont and Lombardy) and the north-eastern one (Veneto and Friuli Venezia-Giulia). The graph shows a positive trend for the north-western area, a negative trend for the north-eastern area, whereas all other areas resulted to have constant trends in addition to very low seasonal pollen indexes (< 50 pollen grains). Data refer to the period 1991–1995.

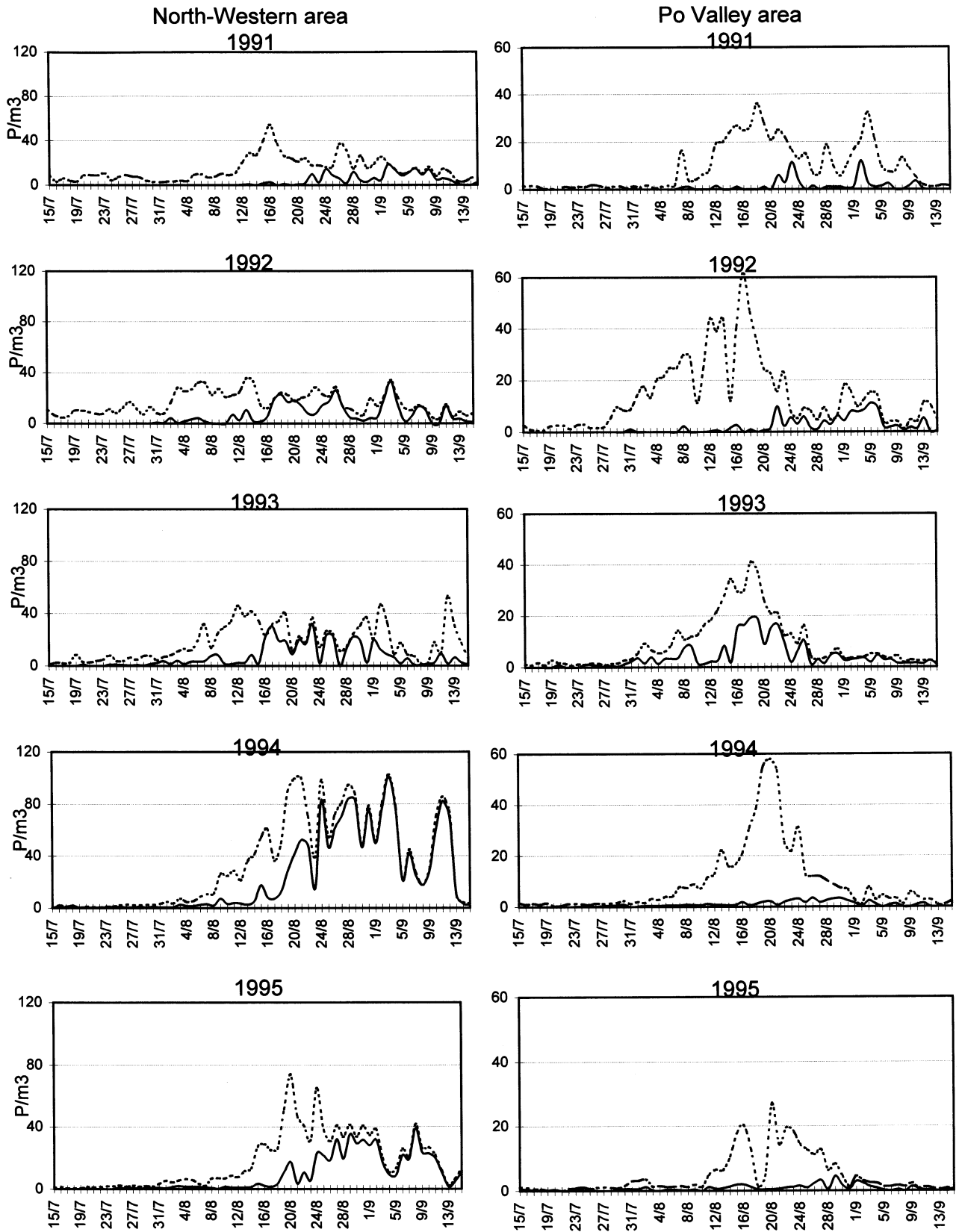


Fig. 5. Pollen curves of the daily mean concentration of ragweed (solid line) and Compositae (dotted line) in the north-western and Po Valley area are shown. They refer to the years 1991 throughout 1995.

above 2 p/m^3 have been considered. The main pollen season (MPS) of the ragweed has been determined considering the period corresponding to 95% of the annual emission, (Pathirane, 1975) and goes approximately from July 15th to September 15th.

5. Results and discussion

The analysis of the pollen concentration trend of Compositae from 1987 to 1995 has been conducted utilising the summation of the daily mean values, which have been grouped by year and referred to as SPI (Fig. 2). In the same figure, the logarithmic regression curves show more clearly the seasonal trend of Compositae pollen in the five selected areas. As can be seen, the north-western area, comprising Piedmont and Lombardy and the north-eastern one, including the Veneto and Friuli-Venezia Giulia regions, show markedly a positive trend. Specifically, in the north-western area, in 1994, the peak values were twice as high as those of 1993 and 1995.

The causes of such abundant pollen production can be of various origin and not all of them are known. Anyway, the influence of climatic factors on the flower-

ing seems to be the most important cause, as the analysis of the meteorological conditions over the north-western area in 1994 has shown a great amount of rain in spring (double that of 1993 and 1995), which has certainly had a positive influence, both on seed germination and on plant development. Moreover, the high temperatures recorded in August 1994 have stimulated further the blooming of Compositae in general and of *Ambrosia* in particular.

Taking into account the fact that the data of some stations, regarding specifically *Ambrosia* were available since 1991, and those of the remaining stations since 1993, the period 1991–1995 has been examined with the purpose of estimating the percentage of *Ambrosia* with respect to total Compositae. Fig. 3 shows percentages of *Ambrosia* of 55–65% over the north-western area, of 20–40% over the north-eastern and Tyrrhenian areas, of $\sim 10\%$ in the Po Valley, whereas in the Central area the percentage of *Ambrosia*, as compared to total Compositae, is $< 5\%$. Furthermore, in the years 1991–1995, ragweed was on the increase in the north-western, Tyrrhenian and Po Valley areas and, to a lower extent, in Central Italy. Instead, over the north-eastern area, the trend has resulted in being slightly negative. The above-mentioned data processing have been carried

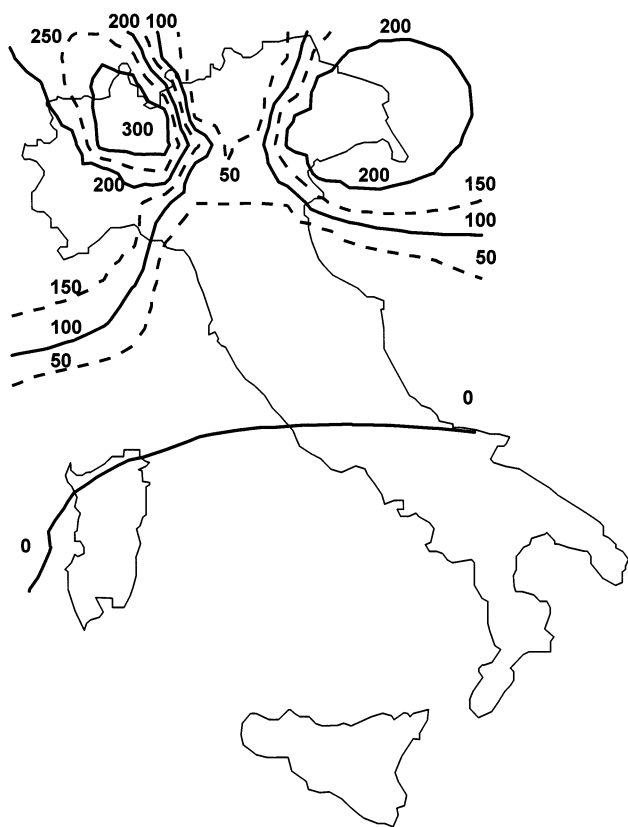


Fig. 6. The isolines represent the spatial distribution of the ragweed pollen production for the year 1995 expressed as SPI, seasonal pollen index (number of *Ambrosia* pollens), and obtained by summation of daily concentration values during the summer season; the zero isoline defines the Southern boundary of ragweed pollen distribution.



Fig. 7. The isolines represent the difference expressed as SPI, seasonal pollen index (number of *Ambrosia* pollens), between the 1995 and 1991 pollen season. The presence of the ragweed pollen during the summer 1995 is increased in the north-western area (+160 pollens) and slightly decreased in north-eastern area (−20 pollens).

out, as already said, on daily mean concentration values. In Fig. 4, two areas show the highest SPI values as compared to the others, namely the north-western one (Piedmont and Lombardy) and the north-eastern (Veneto and Friuli Venezia-Giulia). The graph shows a positive trend for the north-western area, a negative trend for the north-eastern area, whereas all other areas resulted to have constant trends in addition to very low seasonal pollen indexes (< 50 pollen grains). The data refer to the period 1991–1995. In Fig. 5, the pollen curves of the daily mean concentration of ragweed (solid line) and Compositae (dotted line) in the north-western and Po Valley area are shown. They refer to the years 1991 throughout 1995. In order to get a spatial representation of the phenomenon, two maps have been worked out processing the data of the 20 stations listed in Fig. 1. The first map (Fig. 6) represents the 1995 situation expressed as SPI and highlights the two areas with the highest ragweed pollen presence; besides, the zero isoline defines the southern boundary of ragweed pollen distribution. The second map (Fig. 7) shows the pollen distribution trend over the period of time taken into consideration, through the SPI differences recorded between 1995 and 1991: In particular, the zero isoline stands for an unchanged situation, whereas the isolines with either positive or negative values indicate, respectively an increase or decrease in the seasonal presence of pollen. As can be seen in 1995, as compared to 1991, in the western area (Piedmont-Lombardy) a considerable increase took place, whereas in the eastern area (Veneto region), a slight decrease occurred. As an additional factor for a critical evaluation of the results, the problem of the wrong identification of ragweed pollen has been taken into due account. In some cases, such errors could lead to an overestimation of concentration values; as a matter of fact the contemporary presence of Compositae pollen similar to *Ambrosia* is well known, as for instance *Xanthium* sp. *Iva* sp. e *Senecio* sp., which are $\sim 20 \mu\text{m}$ in diameter, tricolporate, spheroid-oblate, but with well differentiated spines and produced, however in much lower quantities.

6. Conclusions

By means of the aerobiological monitoring carried out uninterruptedly by a National Network, quantitative information on the presence and spatial distribution of ragweed pollen, which is considered a significant allergen in north America and presently in some European countries, can be obtained. The data about the allergological importance of ragweed in northern Italy, updated in 1994, show rather low sensitisation, which is probably due to the extremely recent introduction of the plant. Skin tests for ragweed pollen carried out in

the investigated areas have shown the following results: In the north-eastern area, a positive reaction has been observed in 10% of the enrolled patients (Pizzulin Sauli et al., 1992), in the north-western area, in 22% of the investigated cases (Pozzi, 1988) and in the north Thyrrenian area in 6.76% of the cases (Goracci and Goracci, 1996). Thanks to the analysis of *Ambrosia* pollen trend over the period 1991–1995, as compared to the global pollen trend of the Compositae, a considerable intensification of the phenomenon in northern Italy has been recorded, even if with annual fluctuations of a certain extent due probably to substantial variations of the location and intensity of the source (problems of colonisation and competition among the vegetation). As a matter of fact, a decisive factor for ragweed settlement and distribution, in addition to the conditions just mentioned, is that it is among the first plants to prosper on disturbed soils, but is rapidly succeeded in following seasons by other more competitive plants (*Aster* and *Adropogon*) (Ricklefs, 1990) unless the soil is again disturbed. In Italy, the presence of this allergenic plant poses two problems to be faced with great care in the near future: the first is the control over the vegetation growing in the considered territory, both by means of vegetational surveys, and through a more accurate aerobiological monitoring; the second problem concerns the epidemiological aspect and, in particular, the introduction of skin tests for ragweed.

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