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Airborne pollens analysis in Cagliari (south Sardinia): observations on *Ailanthus altissima* (Miller) Swingle, *Casuarina equisetifolia* J.R. & G. Foster and *Schinus molle* L.

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ABSTRACT

In this paper the phenological and airborne pollens dispersal data of *Casuarina equisetifolia* J.R. & G. Foster, *Ailanthus altissima* (Miller) Swingle and *Schinus molle* L., three exotic species widely used for street planting, are examined. The findings have enabled a detailed identification of the phenological stages and to determine the amount of airborne pollens of each species, resulting in a better understanding of their biorhythms and of their pathogenic role.

Key words: *Casuarina, Ailanthus, Schinus,* airborne pollen, Cagliari.

Introduction

Large amounts of pollen of some introduced exotic tree species, widely planted for ornament, have been observed during continuous aerobiological measurements (Ballero et al. 1984, 1985) in Cagliari (South Sardinia, Italy). The airborne pollens concentrations (Fig. 1a) of *Ailanthus altissima* (Miller) Swingle *(Simaroubaceae), Casuarina equisetifolia J.R. & G. Foster (Casuarinaceae), Schinus molle* L. *(Anacardiaceae)* are reported herein and phenological observations as well as some remarks on their palynological features are also provided in order to evaluate how their presence, extraneous to the area, is reflected in the atmosphere.

Ailanthus altissima, a tree which can grow to heights of 30 m, is very adaptable and readily naturalizes in ruderal soils with nitrophilous tendencies; *Casuarina equisetifolia* a tree species native to Australia, has been introduced and is widely planted for afforestation due to its rapid growth. *Schinus molle,* a native of Brazil and known as the "pepper tree" reaches, in our climate, heights of 15-20 m.

Methods

Airborne pollens have been sampled with a Burkard 7-day recording trap similar to that employed by Hirst (1952), placed at 25 m above street level in the town centre of Cagliari. Daily counts have been made using an Orthodox Leitx binocular microscope with a magnification of 400 x. For grain identification Erdtman (1969) and Kapp (1969) have been consulted and checks then made on samples taken directly from the plants in question. Morphometric measurements refer to the average over a sample of 100 grains with a magnification of 600x. As for phenological observations, the National Phenological Network recommendations have been followed, along the lines

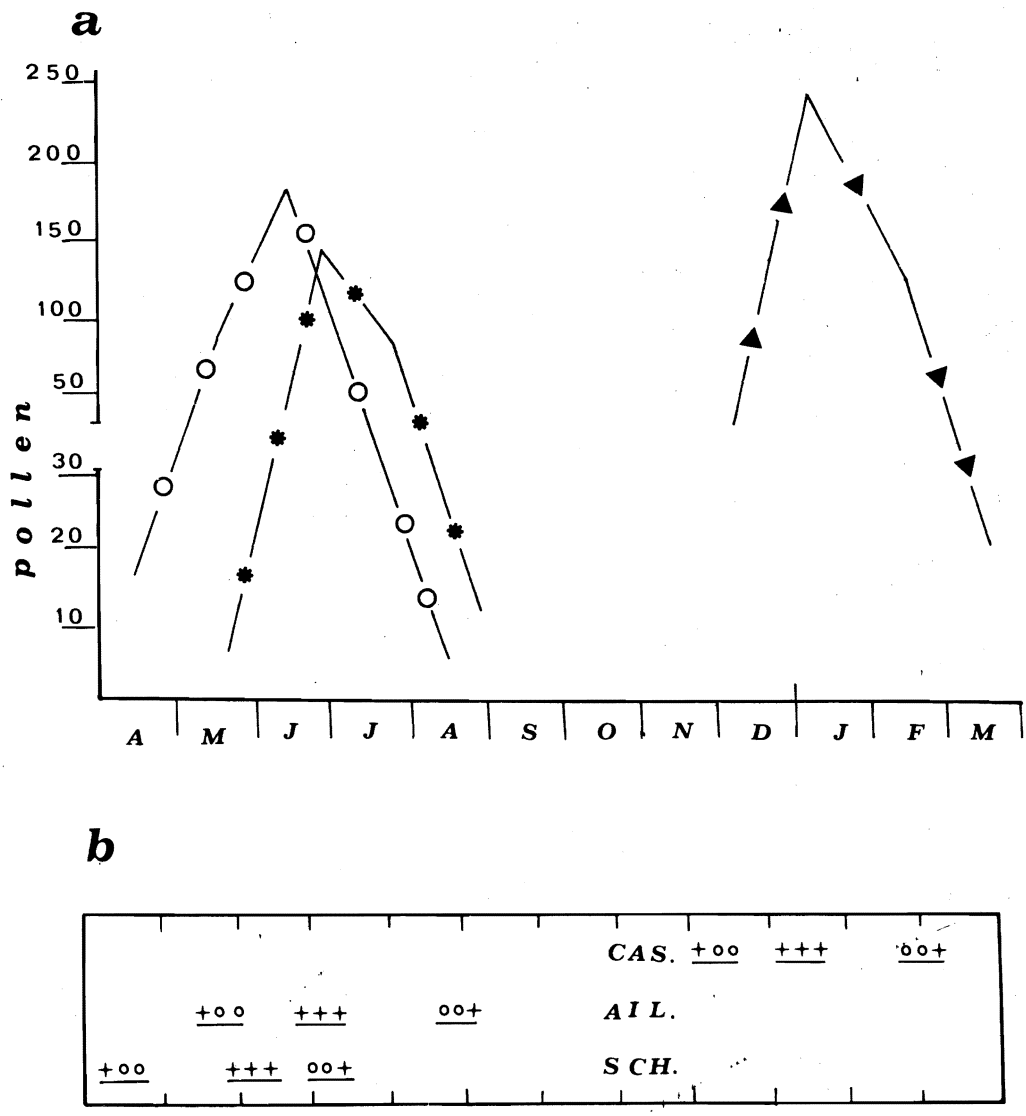

Fig. 1 – (a) Monthly presence from Casuarina (▲▲▲), Ailanthus (★ ★ ★ ★ ★) and Schinus (O O O) pollens; average value 1981-1985. (b) Phenological measurements on the flowering of Casuarina, Ailanthus and Schinus. (+OO beginning of lowerign with presence of buds, +++ acme, OO+ final stages with dried lowers).

suggested by Marcello (1957). For the systematic determination of the three plant species studied, Elliot & Jones (1982) and Everett (1982) have been consulted. All data refer to counts averaged over 5 years (1981-1985) of continuous monitoring.

The Vegetation around Cagliari

Vines, cereals and citrus are cultivated in the countryside around Cagliari. The spontaneous vegetation, typical of submediterranean coast, is strongly affected by the almost perennial strong W NW and S SE winds of over 10 m/sec that often last for days and by a shortage of rainfall (average annual rainfall 400 mm, water deficit 460 mm). In the sands along the coast *Ammophila littoralis* and *Agropyron junceum* associations and *Juniperus oxycedrus* undergrowth flourish: on the cliffs by the sea *Juniperus phoenicea* undergrowth has established. In the humid coastal zone *Typha, Scirpus, Limonium, Inula* and *Chenopodiaceae* sp.pl. associations are found. In the inland plain and highland *Oleo-lentiscentum* is present with *Pistacia lentiscus* as well as *Quercetum ilicis* formations composed typically of *Quercus ilex* or *Quercus suber (Quercetum ilicis suberetosum), Arbutus unedo, Erica arborea,* etc. Numerous introduced species, such as those studied herein, have intruded into these associations, denaturalizing their original composition.

Results and Discussion

The following families were identified in the 1981-1985 sampling campaign: *Pinaceae, Cupressaceae, Casuarinaceae, Salicaceae, Juglandaceae, Betulaceae, Corylaceae, Fagaceae, Ulmaceae, Urticaceae, Polygonaceae, Cheno-Amarantaceae, Caryophllaceae, Papaveraceae, Cruciferae, Rosaceae, Leguminosae, Euphorbiaceae, Simaroubaceae, Anacardiaceae, Tiliaceae, Myrtaceae, Umbelliferae, Ericaceae, Oleaceae, Rubiaceae, Convolvulaceae, Boraginaceae, Labiatae, Plantaginaceae, Caprifoliaceae, Compositae, Liliaceae, Iridaceae, Juncaceae, Graminaceae, Palmae, Cyperaceae.* The highest pollen concentrations were detected in the first six months of the year (Fig. 2) over a period of 150-170 days, in correspondence with flowering which occurs some tens of days earlier in South Sardinia than in other mainland cities such as Genoa, Bari, Naples which share many common features with Cagliari (Negrini & D'Amato 1985).

The annual count (averaged over 5 years) was 27,147 grains per m^3 of air, 3.78% of which produced by trees and/or shrubs and 58.16% by grasses. In addition, 469 (1.73%) pollens of *Typhaceae, Tamaricaceae, Araliaceae, Buxaceae, Lauraceae, Moraceae* and *Solanaceae* were counted and grouped into miscellany as they are not well represented.

The collected pollen grains of *Ailanthus altissima* are prolate spheroidal of 30 x 24 μ with three triangular furrows at the bottom of which lay the colpi. Wartlike striate exine, NPC = 345. Those of *Casuarina equisetifolia* are subprolate with diameter of 30 μ and have pores with onci and rugate exsine, NPC = 346. The pollen grains of *Schinus molle,* Rhus type, are 3-colpate with finely reticulate exine, 25 x 21 μ in size, NPC = 345.

Figure 1 b shows the main anthesis stages of the three species: 000 total absence of flowers, +00 beginning of flowering with flower buds, +++ acme of flowering with buds, open and dried flowers, 00+ end of flowering with presence of only wilting flowers. The monthly pollen count is superimposed on these data. As can be observed, the pollen concentrations faithfully reflect the evolution of the anthesis phenomenon, since in all three species examined the process of pollen ripening is very close to that of its release which occurs, among other things, with considerable intensity.

Ailanthus and *Casuarina* can be considered paleorhythmic in that their phenology appears to be controlled by biorhythms steadily acquired through time and little influenced by extemporaneous climatic conditions. This is supported by the fact that in

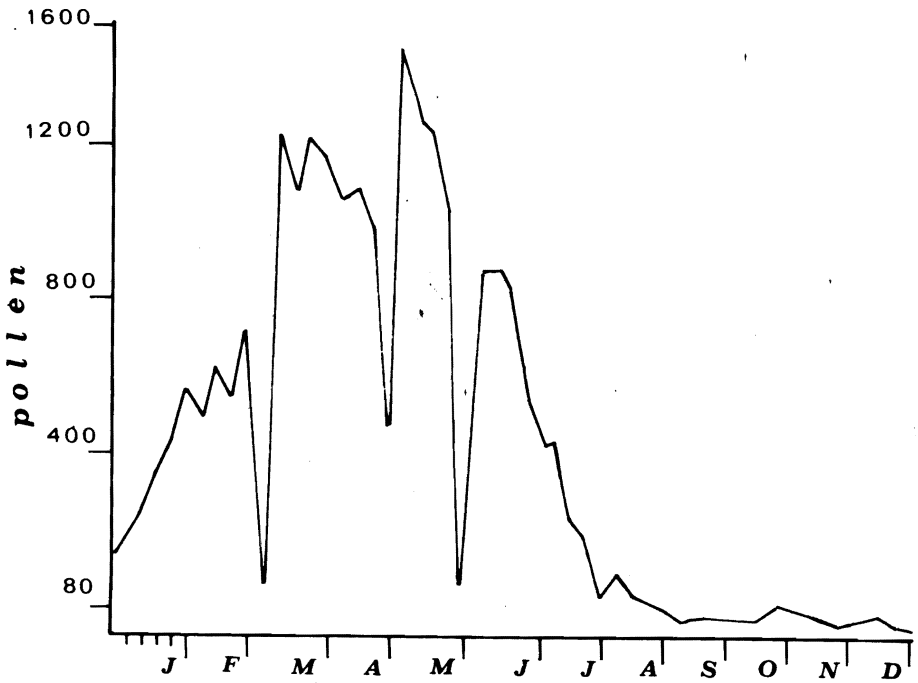

Fig. 2 – Total pollens present in 1 m³ of air in Cagliari. (Average values 1981-1985).

the 5 years of observations, the pollination period and amount of grain released remained constant, despite varying climatic parameters. This is not true of *Schinus* which exhibits a greater sensitivity to temperature (Fig. 3). From a detailed analysis of the circadian rhythms of *Casuarina* (Fig. 4) made possible by its limited pollination period, it emerges that the greater amount of pollen grains is released between 09.00 and 15.00 h, i.e. in coincidence with higher temperatures and a reduction in wind or rain. Conversely, at night this tendency is reversed and almost no pollen was detected in the atmosphere, apart from the grains released during the day and reentrained due to turbolence in the Prandtl stratum, the lowest zone of the atmosphere extending from the laminar sub-layer (of a few cm) for 50-100 m, where the friction between particles constituting the aeroplankton creates turbulent flows, resulting in their vortical dispersion. The marked morphological diversity of these grains, due to the different pressure of the substatum where they settled and to friction with other bodies, confirms that they were released beforehand.

Similar airborne pollen studies of, among others, *Schinus* and *Casuarina*, conducted in Algiers (Korteby et al. 1974) and Tunis (Chadli et al. 1973) where meteoclimatic conditions are similar to those of Cagliari, confirm, qualitatively, the data collected in Cagliari, despite plausible variations in the pollen calendar. However a more specific quantitative comparison is out of the question due to the different sampling procedure, Durham trap (Durham 1946), followed in the African towns.

Useful indications can be drawn from the data reported here as well as valuable phenological elements, also of an applicative nature, such as the problem of hypersensitivity to pollen. Undoubtedly, a more detailed analysis of the production and emission phenomena of pollen grains may provide further insight into the biology of little-known species, not much studied as they do not belong to the autochthonic flora, despite being widely planted.

The identification of pollens of trees such as *Schinus* and *Casuarina,* not recognised as having allergenic properties in Italy, although several non Italian authors (Pott 1922;

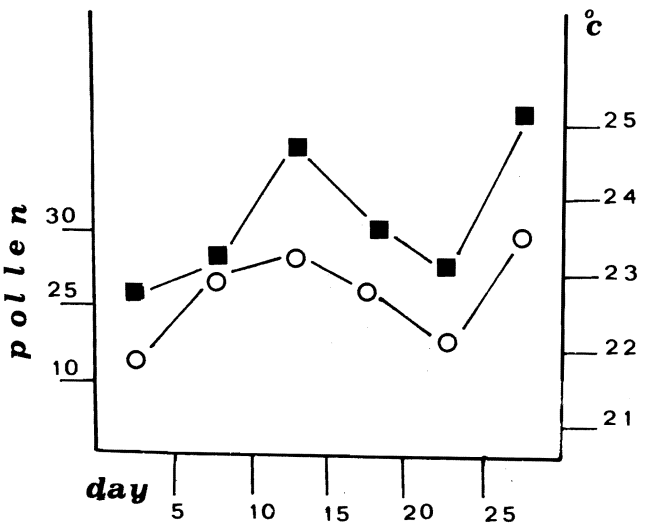

Fig. 3 – Comparison between Schinus pollen (O O O) and daily temperature (■ ■ ■ ■) in Cagliari. Average value: june 1981-1985.

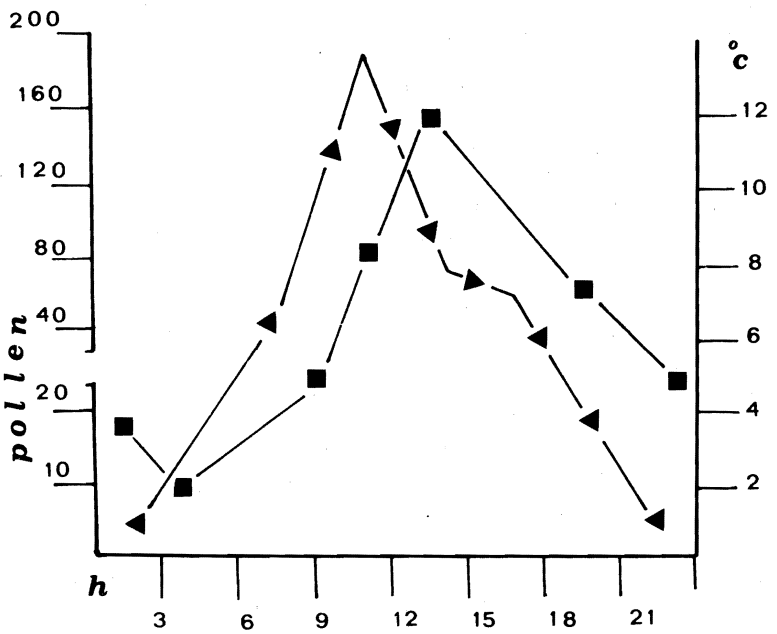

Fig. 4 – Circadian periodicity of Casuarina pollen (■ ■ ■) and daily temperature ▲▲▲ in Cagliari. Average value: junary 1981-1985.

Durham 1951; Charpin *et al.* 1962; Cornillon *et al.* 1972) considered them responsible for pollinosis, could throw some light on the numerous cases of bronchial asthma of non-identified aetiology. As far as *Ailanthus* is concerned, no precise epidemiological data are available even if its pathogenic role has been suggested by Ballero et al. (1985) in some cases of respiratory allergies. Consequently a more detailed allergologic investigation of this species seems expedient.

Conclusions

In this work the airborne pollen concentrations of three exotic tree species have been examined with a view to evaluating their behaviour in an ecosystem substantially different from their native one. These species, which flourish spontaneously in the original habitat in very diverse climatic and ecological environments are well represented inthe atmosphere of Cagliari by their pollen grains. In the context of the local plant associations, their position is instrusive and out of place and likewise their pollens which are potential sources of allergic pathologie, Consequently, prior to introducing new plant species the negative, and sometimes violent, impact, environmental and otherwise, that these species can have on people predisposed to allergies to their pollens need to be evaluated in order to ensure their proper management in the area.

REFERENCES

Ballero, M.; Carluccio, A.; Piu, G. (1984) Rilievi aeropollinici nella città di Cagliari. *Folia Allerg. Immunol. Clin.* 31(1):53-58.

Ballero, M.; Carluccio, A.; Piu, G.; Sechi, P. (1958) Rilievi aerobiologici nell'atmosfera di Cagliari. In: *Aerobiologia e Allergologia Clinica:* 95-98. Lombardo Edit., Roma.

Chadli, A.; Bydzowska, O.: Hugues, J.N. (1973) Etude aeropalinologique de la ville de Tunis. Manisfestations cliniques. Exploration et traitement. *Arc. Istit. Pasteur,* Tunis. 50:291-360.

Charpin, J.; Aubert, J.; Charpin, H. (1962) La pollinose. 1. Exspansion Scient. Franc. Edit., Paris.

Cornillon, J.; Bernard, J.P.; Guemo, E.; Touraine, R. (1972) Le pollinoses estivo-autmnales. *Rev. Franc. Allerg. 4:312-322.*

D'Amato, G.; Negrini, A. (1985) *Aerobiologia e Allergologia Clinica.* 122 pp. Lombardo Edit., Roma.

Durham, O.C. (1946) A proposed standard method of gravity sampling counting and volumetric interpolation of results J. Allergy. 27:79.

Durham, O.C. (1951) The pollen harvest. *Econ. Bot.* 5:230.

Elliot, W.; Ones, D.L. (1982) *Encyclopedia of Australian Plant.* 2:479-487. Lothian Publishing Company P.T.Y., Ltd., Melbourne.

Erdtman, G. (1952) *Pollen morphology and plant taxonomy. Angiosperm.* 539 pp. Almquist & Winksell. Stockholm.

Erdtman, G. (1969) *Handbook of palinology. Morphology-taxonomy-ecology.* 486 pp. Munksgaard, Copenhagen.

Everett, T.H. (1982) *Encyclopedia of horticulture.* 1:91; 2:642; 9:3976. Garland Publishing Inc., New York.

Hirst, J.M. (1952) An automatic volumetric spore-trape. *Ann. Appl. Biol.* 39:257.

Kapp, R.O. (1969) *Pollen and spores,* W.M.C. Brown Company Publishers. Dubuque. Iowa.

Korteby, H.; Abed, L.; Larbaoui, D. (1982) L'atmosphere pollinique d'Alger. *Rev. Alg. Med.* V(2).

Marcello, A. (1957) *Lezioni di geobotanica e Fenologia.* Venezia.

Pott., G. (1922) The pepper tree *(Shinus molle)* as cause of hay fever in South Africa. *S.A.J. Science.* 19;146.