Pollen and Air Pollution

It has been suggested in various contexts that pollen grains are capable of acting as indicators of air pollution.

Energy dispersive X-ray (EDS) analyses of *Vernonia monosis* pollen and the soil in which the plants are growing have shown a particularly good correlation for aluminium and silicon. Aluminium ions are reported to be easily dissolved in acidic soils and are also known to exert a toxic effect on vegetation. The amounts of the elements calcium (Ca), chlorine (Cl), potassium (K), phosphorus (P), and sulphur (S) were significantly higher on the pollen surfaces than in the associated soil samples (Pocock and Vasanthy, 1986).

With regard to the accumulation of heavy metals in pollen, different pathways are reported. According to Pocock and Vasanthy (1986) lead ions are taken up by the roots and transported to the pollen grains, while Ernst and Bast-Cramer (1986) found that lead accumulated in the pollen grains directly from the air.

In connection with an asthma epidemic in Birmingham (UK), numerous crystals were found in the air samples in addition to a large number of spores. The crystals were identified as anhydrous calcium sulphate (Morrow, Brown and Jackson, 1986).

In a New Zealand study of pine pollen (*Pinus radiata*) it was concluded that pollen germination and metabolic activity was inhibited by high levels of SO_2 (O'Connor *et al.*, 1987). Similar results have been reported by Varshney and Varshney (1981) regarding pollen tube growth in various types of pollen. Flückiger *et al.* (1978) have studied the effects of air pollution on pollen exposed to exhaust gases near a highway and demonstrated that both germination and pollen tube growth were impeded. The effects of atmospheric pollutants, SO_2, NO_2 and CO on some airborne pollen grains have been studied by Ruffin *et al.* (1982, 1986). Their preliminary results show that the gaseous contaminants may change the protein structure and, possibly, the allergenicity of the pollen grains.

Methods

In connection with collaborative work between the Palynological laboratories in Stockholm and Paris, particles on polluted grass - and birch - pollen have been analyzed using the EDAX-method (X-ray elemental analysis). Since this method sometimes appears inadequate, because of electron penetration below the very surface of the exine, additional methods are in the process of being tested.

Results

Peaks of the following elements were found in particles attached to the surface of grass-pollen (*Dactylis*) : P, S, Cl, K, Ca (Fig. 1). In similar particles on birch-pollen (*Betula*) a pollutant peak of Al was also registered but K was missing (Fig. 2). Particulate matter on the surface of *Plantago*-pollen mainly contained Al, S and Ca while the other elements were less evident (Nilsson, 1988).

Different areas of untreated *Betula*-pollen were analyzed with respect to various elements (% of total elemental content). Potassium was dominant in all regions with the highest values in the polar area. Cl and Ca showed

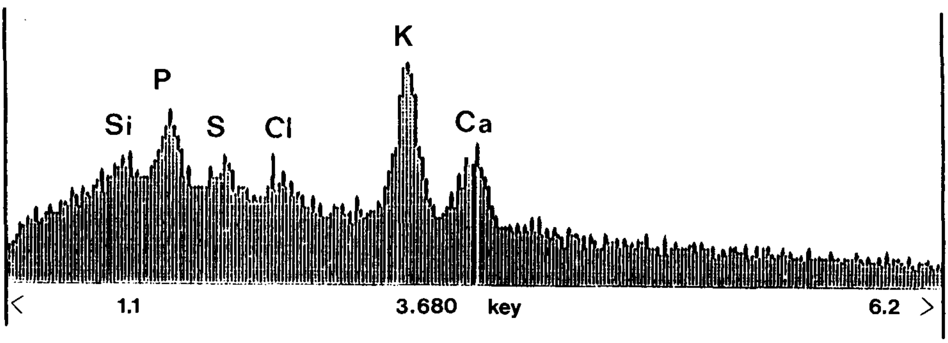

Fig. 1. Elemental analysis (EDS) of inorganic particles on pollen of Dactylis glomerata *(Nilsson, 1988).*

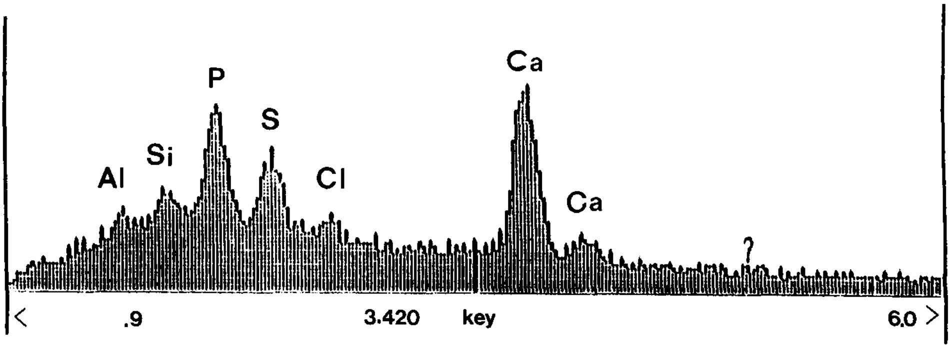

Fig. 2. Elemental analysis (EDS) of inorganic particles on pollen of Betula *sp. (Nilsson, 1988).*

remarkably similar distributions with slightly higher values in the pore area, while sulphur was dominant in the interapertural areas (Fig. 3). Phosphorus was dominant in the pore region (cf. Ca and Cl). In one mineral particle associated with birch-pollen Si was clearly dominant, while another particle contained mostly Ca and K (Fig. 4).

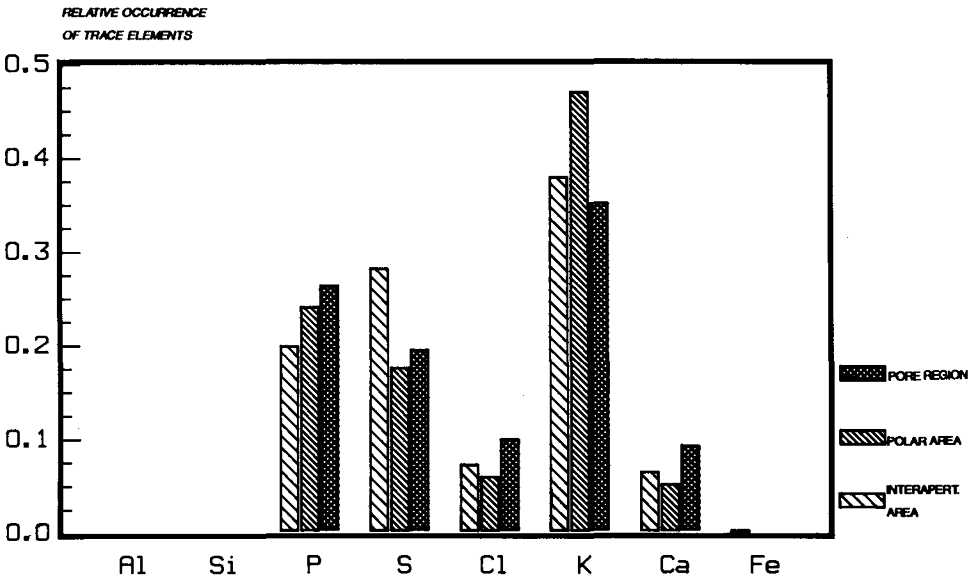

Fig. 3. Elemental analysis (EDS) of different areas of untreated, unexposed Betula-*pollen.*

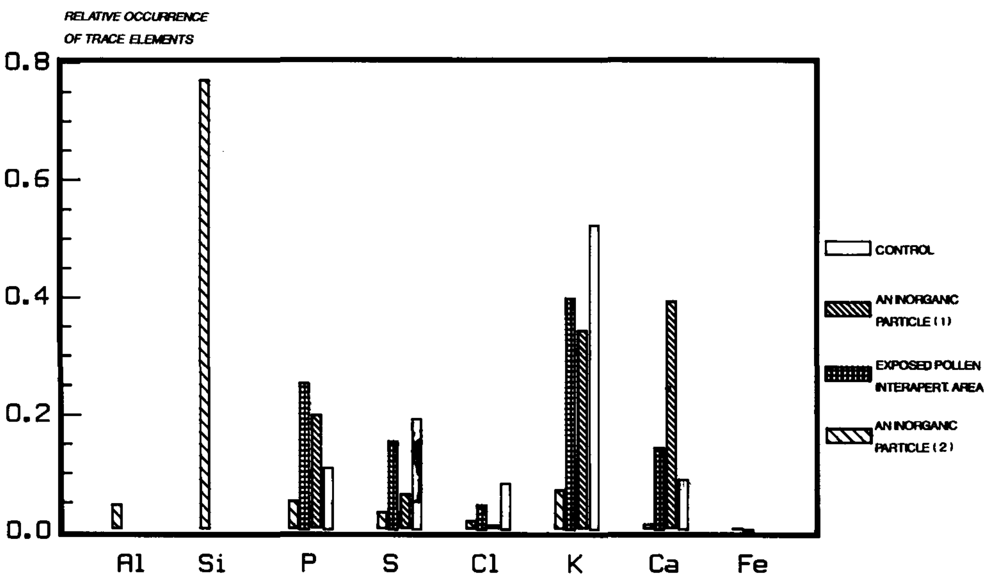

Fig. 4. Elemental analysis (EDS) of pollen and particles adhering to the surface of exposed Betula-*pollen.*

Discussion

The interaction between airborne particulate pollutants and pollen grains is largely unknown. These preliminary studies show that sampling- and analysis methods need to be improved in order to better identify and understand the presence, quality, quantity and significance of particles adhering to the pollen surface.

Air pollutants appear capable of changing pollen development, viability, fertility, and the physiological-biochemical properties of the airborne pollen, thus endangering pollination, reproduction ability, seed setting, plant breeding and possibly allergenicity.

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REFERENCES

ERNST, W.H.O. and BAST-CRAMER, W.B., 1980, *The Effect of Lead Contamination of Soils and Air on Its Accumulation in Pollen*, in *Plant and Soil*, 57, p. 491-496.

FLÜCKIGER, W., BRAUN, S. and OERTLI, J.J., 1978, *Der Einfluss verkehrsbedingter Luftverunreinigungen auf die Keimung und das Schlauchwachstum bei Pollen von* Nicotiana sylvestris, in *Environ. Pollut*, 16, p. 73-80.

MORROW BROWN, H. and JACKSON, F.A., 1986, *Airborne Crystals of an Hydrous Calcium Sulphate - a New Air Pollutant*, in *Proc. 3. Internat. Conf. Aerobiol. Basel 6-9 Aug.*

NILSSON, S., 1988, *Poursuite des analyses de la pollution particulaire des pollens*, in *Ann. Sci. Nat. Bot. Paris Ser.*, 13, 9, p. 125-132.

O'CONNOR, C.J., ASHFORD, K.P. and SPEDDING, D.J., 1987, *Germination and Metabolism of* Pinus radiata *Pollen in the Presence of Sulfur Dioxide*, in J. *Plant Physiol.*, 126, p. 373-378.

POCOCK, S.A.J. and VASANTHY, G., 1986, *EDS Analysis of Pollen Wall Surfaces of* Vernonia monsis *Cl. (Asteraceae) and Pollen-Soil Concentration of Elements*, in *Geophytol.*, 16(1), p. 37-53.

RUFFIN, J., WILLIAMS, D., BANERJEE, U.G. and PINNIX, K., 1983, *The Effects of Some Environmental Gaseous Pollutants on Pollen-wall Proteins of Certain Airborne Pollen Grains*, in *Grana*, 22, p. 171-175.

RUFFIN, J., LIU, M.Y.G., SESSONS, R., BANERJEE, S. and BANERJEE, U.G., 1986, *Effects of Certain Atmospheric Pollutants (SO_2, NO_2 and CO) on the Soluble Amino Acids, Molecular Weight and Antigenicity of Some Airborne Pollen Grains*, in *Cytobios*, 46, p. 119-129.

VARSHNEY, S.R.K. and VARSHNEY, C.K., 1981, *Effect of Sulphur Dioxide on Pollen Germination and Pollen Tube Growth*, in *Environ Pollut. Ser. A*, 24, p. 87-92.