

EFFECTS OF AIR CHEMICAL POLLUANTS OF THE LEAF  
OF SOME CULTURED PLANTS *SECALE CEREALE* L., *TRITICUM*  
*AESTIVUM* L., *ZEAMAYS* L. IN THE SĂVINEȘTI NEAMȚ  
INDUSTRIAL AREA

GEORGETA FILIPESCU, TAMARA MOTIU, C. TOMA

The investigations carried out in the Săvinești-Neamț industrial area have pointed out that the noxious action of the air chemical pollutants induced some morpho-structural changes in the leaf of certain cultured plants of a wide morphological and ecological variability such as: *Secale cereale*, *Triticum aestivum* and *Zea mays*, Gramineae family.

The structure of the lamina was extensively studied, especially that of its food and fodder value, by both Romanian and foreign research workers [3, 7]. We mention that the changes, adaptive structural features, determined by the environmental conditions or the alterations induced by the various chemical pollutants are discussed but in few treatises of morphoanatomy.

The investigated area is of 25–30 km<sup>2</sup> in surface being situated lengthways the Bistrița Valley and it is characterized by the great increase of terraces, as a result of alluvia deposition carried from the mountain region of the Oriental Carpathians. The crust of the land consists of alluvial soils placed on the river meadow and brown mesobasic forest soil present on the terraces higher than 4–6 m. The climate is characteristic for the external sub-Carpathian area, with average annual temperatures between 9–10°C, average precipitations of 550–650 mm and winds mainly from the NW.

#### Material and method

The investigated material was collected in different periods of plant vegetation and at different distances from the pollution source the Industrial Complex for Chemical Fibres and Yarns, Săvinești: *Secale cereale*, from S<sub>1</sub>A+B, S<sub>2</sub>A+B and S<sub>1</sub> stationaries, *Triticum aestivum* from Izvoare I and Roznov I and *Zea mays* from Izvoare II and Roznov II.

The histo-anatomical observations were carried out on cross-sections performed at three levels of the lamina (the epidermis being also removed). For each species the leaves of 2–3 samples were comparatively sectioned, these being collected both from stationaries situated at a certain distance from the Industrial Complex, under conditions unaffected by the chemical pollutants

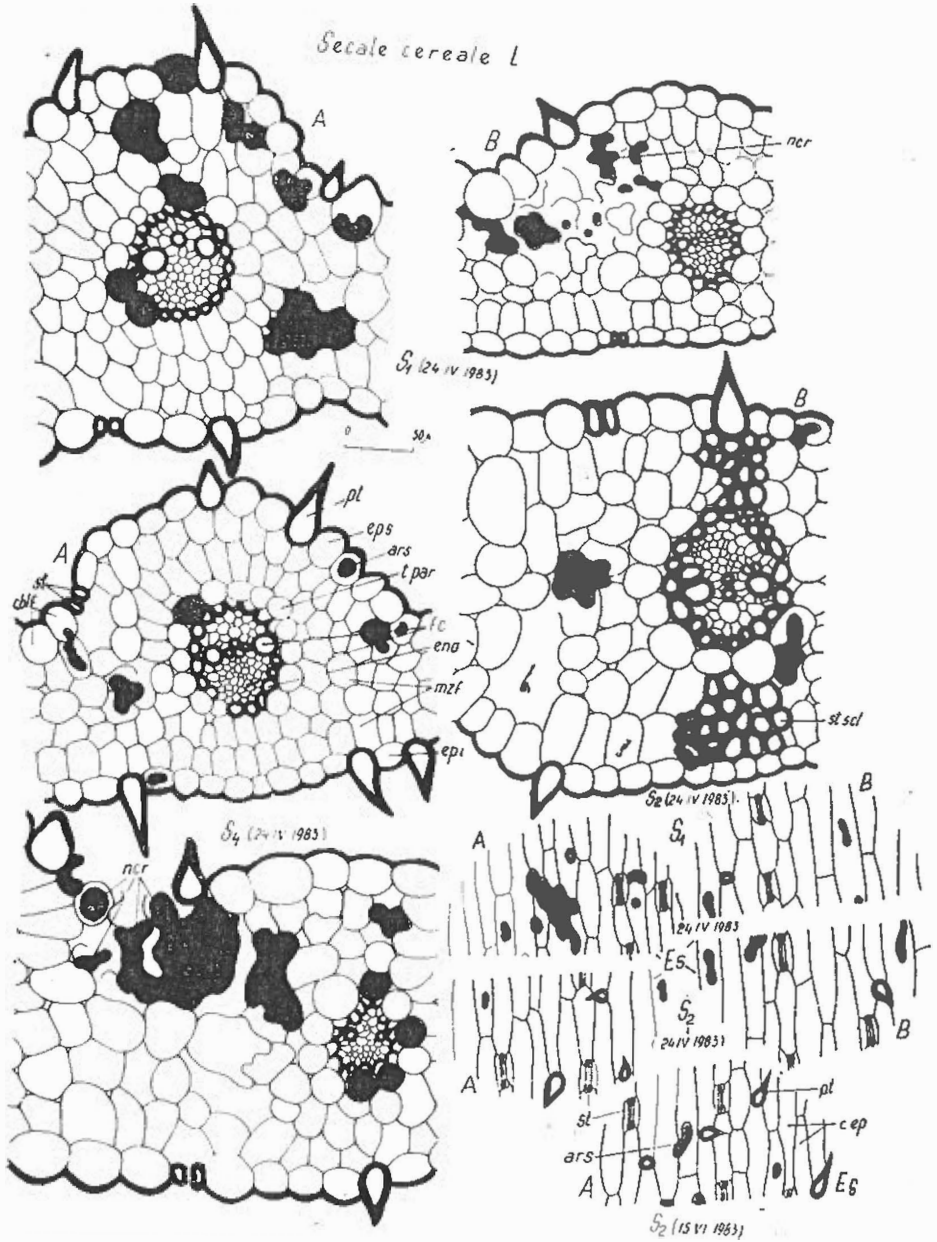


PLATE I— Details of the cross sections (*S*<sub>1</sub>—A, B; *S*<sub>2</sub>—B; *S*<sub>4</sub>—A) and face views (*Es*; *S*<sub>1</sub>—A, B; *S*<sub>2</sub>—A, B). Through the lamina of *Secale cereale* L. median level in young phase: *S*<sub>1</sub>, *S*<sub>2</sub>, *S*<sub>4</sub>; stationaries with *Secale cereale* around the factory.

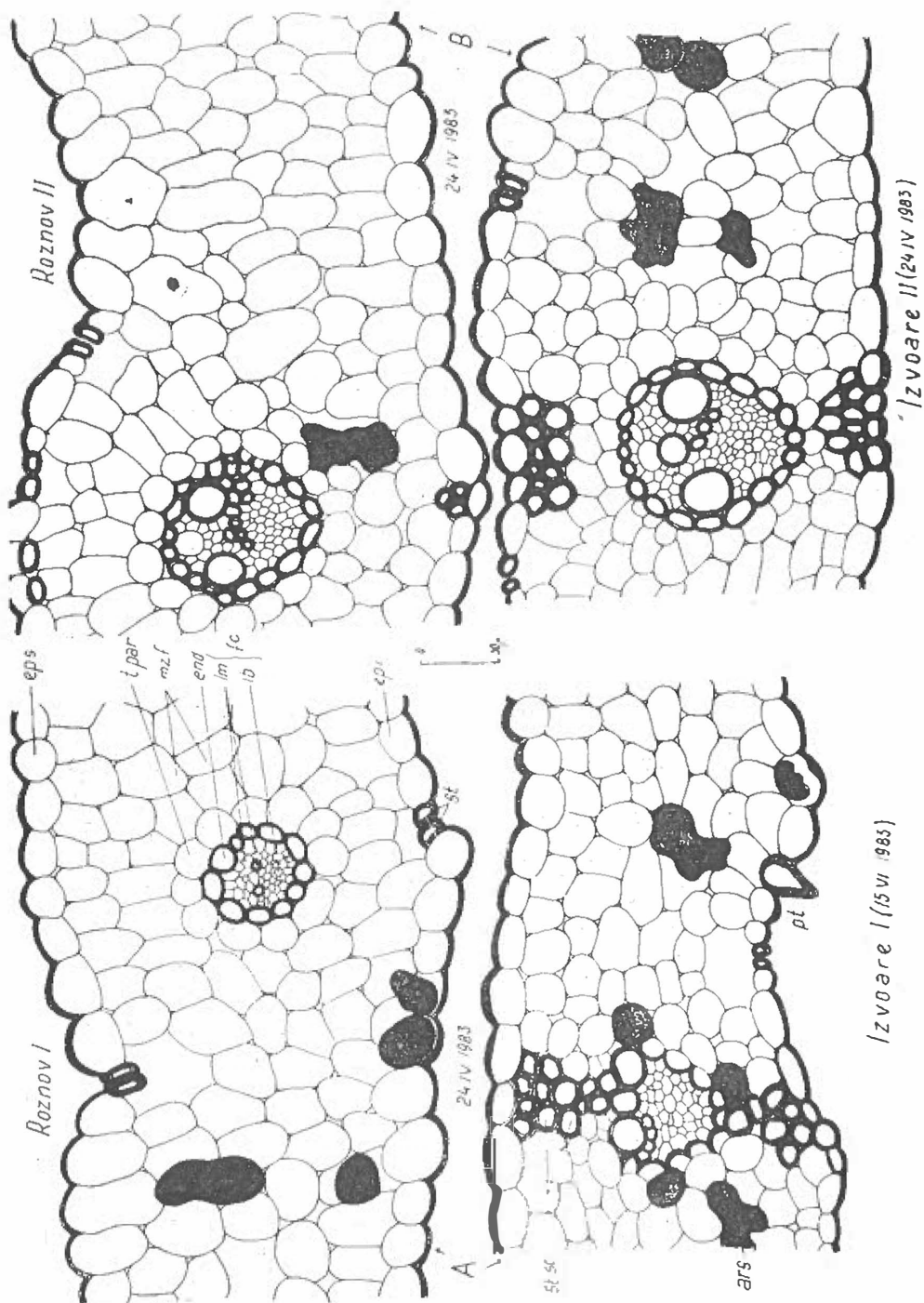


PLATE II — Details of the cross sections (Izv. I, Izv. II, Rz. I, Rz. II) through the lamina of *Zea mays* L. (median level) in young and mature phases; Izv—Izvoare, Rz—Roznov; I region with great concentration of noxious agents; II region with moderate concentration of noxious agents.

A — burnt lamina; B — green lamina; ars — burn; c. blf. — bulliform cells; c. ep — epidermal cells; end — endodermis; ep — lower epidermis; ep. s. — upper epidermis; f.c. — vascular bundle; es — phloem; lxi — xylem; mzf — mesophyll; nor — necrosis pt — trichome; st — stomata; scl — sclerenchyma pillar; t. par — parenchymatous sheath.

and from those situated in the close vicinity of the emanation source, under conditions of more or less intense pollution.

Of the air chemical pollutants the prevalent noxious agents produced by the Industrial Complex for Chemical Fibres and Yarns are the sulphur dioxide, ammonia and nitric oxides. Acrylonitrile, phenol and chlorine, as well as other organic and inorganic compounds are but intermittent pollution sources.

The toxicity of the emanations affects mainly the leaves the most sensitive vegetable organ, followed by the stem and root. The respective products enter directly through stomata into the assimilating tissue or get solved in the precipitations water (the case of gases) falling on the leaves surface.

On the surface of the leaves phenomenon exteriorizes by the occurrence of some punctiform, spots, isolated at the beginning, which, extending in time join together.

The leaves lose their colour between nervures becoming chlorotic, sometimes acquiring by the aspect of some spots of irregular shape and light brown in colour, an inlag appearance as in *Zea mays*. In *Secale cereale* and *Triticum aestivum* specimens the leaves present evident scalds. The spots, initially chlorotic, become in time necrotic, elongated in shape, being situated between nervures, in the vicinity of which a green area is usually also present.

The necrosis has initially an apical site, beginning with the top of the limb, advancing towards its middle, the main nervures being avoided in all the three species. In all cases, in the young leaves the necrosis is followed by the limb rolling up especially at the base and, sometimes, by its falling off.

From the structural point of view the three studied species present various alterations induced by the noxious effects of the pollutants, both at the level of epidermis and of the mesophyll.

*In the epidermis*, partial or total distortions of the epidermal cells (Plates I, II), different thicknesses of the cuticle and of the outer walls in the upper epidermis of the limb, a reduced density, of the stomata, changes of the somatic cells size, distortions, more or less marked by dehydration, of the bulliform cells and sometimes ruptures at their level (Plate II) were found.

*In the mesophyll* of the leaves exposed to the action of the pollutants in the vicinity of the Industrial Complex for Chemical Fibers and Yarns, a varying number of layers in the assimilating tissue, changes in form and distribution of the assimilating cells around the nervures, reduced thickness and lignification of the sclerenchyma fibers forming the mechanical pillars near the great vascular bundles were noticed.

*The vascular tissue* also presents some variations like those in the diameter of the great vascular bundles, the shape of the perivascular sheath, the distance between the vascular bundles as well as in the histological structure of the small vascular bundles.

In cases of more advanced pollution (July, 1983) due to the accumulation of the toxic compounds in chloroplasts, the structural impairment of plastids, affecting to a great extent the process of photosynthesis was noticed.

### Conclusions

Based on the morpho-histo-anatomical observations on the three cultured plants (*Secale cereale* L., *Triticum aestivum* L., *Zea mays* L.) and on the scanty data in the literature regarding the plants resistance to various pollutants (3, 4, 6) the following conclusions were drawn: in the Săvinești-Neamț in-

dustrial area all the species investigated by us were affected by the emanated toxic gases, with the specification that in similar bio-ecological conditions their sensitivity differs. The most sensitive species proved to be *Triticum aestivum* followed by *Zea mays*. The most resistant species to the action of the air chemical pollutants in the respective area seems to be *Secale cereale*, this one vegetating well enough under the conditions of high concentrations of noxious substances.

Most of the young plants, at the beginning of their vegetation period (eg 24. IV. 1983, 15. IV. 1984) are more strongly affected than the adult ones investigated during the summer (eg 15. VI. 1983).

We have also noticed :

- A slowing down of the growth rate, leading to an early fading of the leaves;
- A reduction of the assimilating surface, so that the leaves do not reach normal sizes;
- The occurrence of irreversible lesion (chlorosis, scalds necrosis, distortions) on leaves;
- Degradation of the chloroplasts, a quantitative decrease of the green assimilating pigments and a quantitative increase of the carotenoid pigments; all these affect the photosynthesis, and in general, the metabolism of the plant.

From the analysis of the above data we can make some suggestions on the cultivation of some plants in the vicinity of the Săvinești-Neamț industrial area. Thus, we recommend the planting of some protective forest by it made up of wooden and herbaceous species, of a xeromorphous structure, resistant to pollutants (eg. *Abies nordmaniana*, *Platanus orientalis*, *Fraxinus ornus*, *Rhamnus cathartica*, etc), which can prevent to a great extent the spreading of pollutants;

— the completely compromised areas should no more enter into the agricultural circuit; they should be cultivated with plants of an increased resistance to pollution, such as beet, tomatoes, etc.;

— in the areas where the chemical pollutants present high concentrations we suggest the cultivation of fodder rye which proved to be much more resistant than the other graminaceae;

— the designing and building of outfits and technologies for air impurifiers intake and retain as an important means in preventing the actual concentrations of the emanations in the air and the toxic effects on the plants cultivated in the environment;

— in the end, we believe that a cartography of the area affected by pollution, correlated with biochemical, morpho-anatomical, physiological investigations and with the dosage of the pollutants accumulation in the vegetable organisms, is essential for selecting the plants more adaptable to the specific pollutants in the respective area.

#### B I B L I O G R A P H Y

1. IONESCU AL., T. MOSCALU, 1973 — *Productivitatea plantelor in zonele cu atmosferă impurificată*. Probl. Agricole nr. 5, București
2. LEMKE J., 1961 — *Influența fumului industrial asupra creșterii pădurilor suburbane de lângă Poznań*, Sylwan nr. 6

3. METCALFE C.K. and L. CHALK, 1960 — *Anatomy of the Monocotyledons. I. Graminae*, Oxford
4. MIHĂILESCU I. F., D. GRINEA, 1977 — *Aspecte ale poluării atmosferei în zonele industriale ale văii Bistriței*. Anuarul Muz. de St. Nat. Piatra Neamț
5. NICOLAEVSKIJ C. B., 1979 — *Biologičeski osnovi gazovsloživosti rastenii*. Izdatelstvo „Nauka“ Sibirscoe stađenie, Novosibirsk, p. 61—135
6. POPESCU A., V. SANDA, 1972 — *Efectele poluării atmosferei din unele centre industriale asupra plantelor*. Ocrotirea naturii, nr. 2, București
7. SĂVULESCU TR., 1933 — *Graminaceae (morfologie, fiziologie, biologie, sistematică, filogenie, răspindirea geografică)*, curs litografiat, București