

SR-XRFA in Botanical Research: Elemental Composition of Species of the Genus *Syringa* (Oleaceae) under Technogenic Impact in Novosibirsk

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A study has been first made of the element composition of both the plants of two species of the genus *Syringa*, growing under technogenic impact in Novosibirsk and the soil samples from their habitat by method of X-ray fluorescence analysis using synchrotron radiation (SRXRF) at the station of element analysis of SCSTR of the Institute of Nuclear Physics SB RAS (VEPP-3 store ring).

The material studied was represented by the plants of two species - *Syringa josikaea* and *S. vulgaris*, represented by three cultivars: 'Nadezhda', 'Olimpiada Kolesnikova', 'Pamjat' o Kirove', growing in conditions of technogenic impact and background, collected in Novosibirsk.

Experimental. The hinge-plates of air-dried plants and soil (1 g) were crumpled up in an agate mortar and pressed as tablets of a diameter of ~ 1 cm weighing 30 mg (of a surface density of 0.04 g/cm²). The elements were determined using the SRXRF method at the station of element analysis (VEPP-3 store ring) of the Siberian Center of Synchrotron and Terahertz radiation, INP, SB RAS. The samples were measured at an exciting radiation energy of 23 keV. The duration of each measurement varied from 300 to 500 s for vegetation and soil hinge-plates. Synchrotron radiation was monochromatized with a monochromator based on a silicon crystal of the "butterfly" type with working planes (111). Fluorescence radiation was recorded using a detector PentaFET (Oxford Instruments) with an energy resolution of about ~135 eV (Fe K α line; 5.9 keV). The main characteristics of the experimental station and the methodical aspects of the work are described in (Daryin, Rakshun, 2013; Experimental station...).

DISCUSSION

A comparative analysis of the soil from the points of sampling of plant samples showed an excess in the content of V, Zn, Br, Pb and a decrease in Mn in urban soils compared with the background.

The study of the content of macro- and microelements in the aerial organs of representatives of the genus *Syringa* showed that the concentration of macroelements K and Ca is higher in the leaves than in the stems, regardless of the taxon and place of growth. The highest total content of K and Ca is revealed in the leaves of *S. josikaea*. It was found that in plants under technogenic impact, the content of Mn, Fe, Co, Cr, Br, Rb, Nb increased and Zn and Mo decreased compared to the control, the most severe heavy metal pollution in urban conditions was observed in plants of *S. josikaea*.

The biogeochemical transformation coefficient (Zv) was calculated: $Zv = \sum_1^{n_1} Kc + \sum_1^{n_2} Kp - (n_1 + n_2 - 1)$ [Kosheleva et al., 2013]

n_1, n_2 – number of elements $c Kc > 1.5$ и $c Kp > 1.5$.

$Kc = Cp/Cb$ (chemical element concentration coefficient); $Kp = Cb/Cp$ (chemical element scattering coefficient).

Table. The biogeochemical transformation coefficient (Zv)

Species of the Genus <i>Syringa</i>		Zv
<i>S. josikaea</i>		36,5
<i>S. vulgaris</i>	cv. 'Pamyat' o Kirove'	22,8
	cv. 'Olimpiada Kolesnikova'	23,6
	cv. 'Nadezhda'	28,2

Plants of the cv. 'Pamjat' of Kirov' variety (Zv = 22.8) are most resistant to pollution.



Syringa vulgaris cv. 'Pamjat' of Kirov' (photo E. Lyakh)

RESULTS.

1. To analyze the differences in soil samples, taken from the different habitats

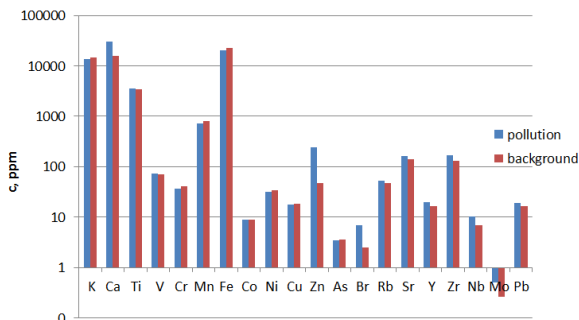


Fig. 1. Contents of elements in the soils of the habitats (ppm).

2. A comparative analysis of the content of elements in plants

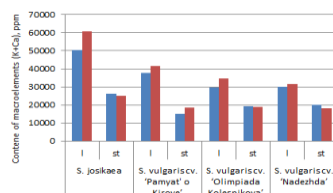


Fig. 2. Total Contents of macroelements (K and Ca) in the aerial organs of *Syringa* plants from pollution (1) and background (2) plots

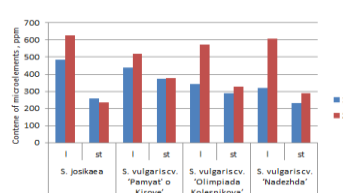


Fig. 3. Total Contents of microelements in the aerial organs of *Syringa* plants from pollution (1) and background (2) plots.

As a result, reliable data were first obtained on the content of 20 elements in samples of two species of the genus *Syringa* in the urban ecosystem of Novosibirsk. The species and cultivars that are most tolerant to pollution in urban conditions, which can be recommended for widespread use in green construction, are identified. The data obtained on the elemental composition of plant samples and soils may be included in the databases.