

Original Article**Nitrogen and Sulphur Pollution in Cluj-Napoca, Using Ornamental Trees as Biomonitors****Narcisa PENEGHI¹, Ioan OROIAN^{1*}, Antonia ODAGIU¹, Ilie COVRIG²**¹*Faculty of Agriculture, University of Agricultural Science and Veterinary Medicine, Mănăştur St. No. 3-5, 400372 Cluj – Napoca, România*²*Faculty of Horticulture, University of Agricultural Science and Veterinary Medicine, Mănăştur St. No. 3-5, 400372 Cluj – Napoca, România*Received 15 June 2015; received and revised form 20 June 2015; accepted 8 August 2015
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Abstract

A increasingly encountered practice in agglomerated towns, consists in using ornamental trees or forest trees for monitoring environmental air pollution. The aim of our study was to carry out a monitoring experiment in order to emphasize the nitrogen and sulphur pollution in Grigorescu district of Cluj-Napoca. The study was carried out from April to June 2014, *Acer platanoides*, and *Juglas regia*. Data were statistically processed using IBM SPSS 20 Office. High nitrogen and sulphur contents in trees foliar tissue was emphasized.

Keywords: *Acer platanoides*, *Juglas regia*, harmful effect, heavy traffic.

1. Introduction

A increasingly encountered practice in agglomerated towns, consists in using ornamental trees or forest trees for monitoring environmental air pollution [1, 5, 7]. The scientific basis of this practice is represented by trees sensitivity against different pollutants, from particulate matters, generally speaking, to majority of heavy metals (zinc, cadmium, lead, copper, mercury, etc.) and also sulphur and nitrogen. Pollution with those metals can cause trees a series of severe physiopathies [2, 3, 4, 6]. Concerning Romania, we emphasize the lack of serious studies concerning the use of trees, which are usually planted in towns in parks of other spaces, as monitoring agent, even some valuable exceptions may be mentioned [1].

The aim of our study was to carry out a monitoring experiment in order to emphasize the nitrogen and sulphur pollution in a populated area of Cluj-Napoca, the second urban agglomeration of the country, according to the last census. In this aim we use ornamental tree species as biomonitoring agents.

2. Material and Method

During a three months period, from April 2014 up to June 2014, a monitoring study was conducted. The monitoring place is a high populated place located in Grigorescu District of Cluj-Napoca.

The nitrogen and sulphur pollution was studied. This pollution, in studied area, has as main source the traffic. The above mentioned elements occurrence in urban air is encountered as oxides for, nitrogen oxides, and sulphur dioxide, respectively. Thus, it was studied the action of these pollutant gaseous substances on trees leave tissues. A mobile monitoring device was use to quantify the

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occurrence of targeted gaseous air indicators taken into consideration in our study. The measurements were taken twice a week. *Acer platanoides*, and *Juglas regia* were tree species taken into study.

The leaves tissue chemical analysis performed in order to quantify the nitrogen and sulphur content, was carried out within the Laboratory of Environmental Quality and Plant Protection from the University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca. Present standards of sulphur and nitrogen

quantification from vegetal tissues, were taken into consideration when chemical analysis was carried out. Data were statistically processed with IBM SPSS 20 Office soft.

3,Results and Discussions

The observational monitoring emphasize the presence of sulphur dioxide in average concentration of $4.55 \mu\text{g}/\text{m}^3$, and nitrogen oxides in concentrations of $50.21 \mu\text{g}/\text{m}^3$, expressed by entire experimental period (Table 1).

Tab. 1. The sulphur and nitrogen oxides air concentrations (SO_2 , $\text{NO}_x - \mu\text{g}/\text{m}^3 -$) recorded in monitoring point located on Grigorescu District of Cluj-Napoca, April-June 2015

Statistical indicator	$\text{SO}_2, \mu\text{g}/\text{m}^3$	$\text{NO}_x, \mu\text{g}/\text{m}^3$
n	25	25
Mean	4.55	50.21
Variance	0.90	51.84
Standard deviation	0.95	7.20
Standard error of average	0.19	1.44
Coefficient of variation	20.87	14.35
Skewness	0.28	0.71
Kurtosis	1.16	0.92

The mean, expressed by entire experimental period, of the nitrogen in *Acer platanoides* leaves was of 925.60 ppm, while sulphur content was of 38452.31 ppm (Table 2).

The dispersion parameters demonstrate a normal distribution.

The coefficient of variation of 1.68% for sulphur content, and 2.34% for nitrogen content in

Acer platanoides leaves, respectively, demonstrates the viability of results (Table 2). *Acer platanoides* leaves aspect confirm the harmful effect of both nitrogen and sulphur pollution (Fig. 1).

The mean, expressed by entire experimental period, of the nitrogen in *Juglas regia* leaves was of 915.21 ppm, while sulphur content was of 32488 ppm (Table 3).

Tab. 2. The statistical indicators of the sulphur and nitrogen concentration (ppm) in *Acer platanoides* leaves used as bioindicator in monitoring point located on Grigorescu District of Cluj-Napoca, April-June 2015

Statistical indicator	S, ppm	N, ppm
n	25	25
Mean	925.60	38452.31
Variance	243.36	816402.60
Standard deviation	15.60	903.55
Standard error of average	3.12	180.71
Coefficient of variation	1.68	2.34
Skewness	1.34	1.25
Kurtosis	1.46	3.14

Tab. 3. The statistical indicators of the sulphur and nitrogen concentration (ppm) in *Juglas regia* leaves used as bioindicator in monitoring point located on Grigorescu District of Cluj-Napoca, April-June 2015

Statistical indicator	S, ppm	N, ppm
n	25	25
Mean	915.21	32488.00
Variance	430.56	4434183.06
Standard deviation	20.75	2105.75
Standard error of mean	4.15	421.15
Coefficient of variation	2.26	6.48
Skewness	1.14	0.47
Kurtosis	0.96	1.35

The dispersion parameters demonstrate a normal distribution. The coefficient of variation of 2.26% for sulphur content, and 6.48% for nitrogen content in *Juglas regia* leaves, respectively,

demonstrates the viability of results (Table 3).

Juglas regia leaves aspect confirm the harmful effect of both nitrogen and sulphur pollution (Fig. 2).



Figure 1. Leaves of *Acer platanoides* affected by synergic effects of SO₂ and NO_x pollution



Figure 2. Leaves of *Juglas regia* affected by synergic effects of SO₂ and NO_x pollution

The observational monitoring emphasize the presence of physiopathies specific symptoms on foliar tissue in all studied ornamental trees species, *Acer platanoides*, and *Juglas regia*, respectively. The laboratory analyse confirm the presence of high nitrogen and sulphur content in sampled foliar tissue from tree species, especially in last part of the monitoring time interval.

Conclusion

The air pollution in urban areas may be monitored using ornamental trees, because they are strongly influenced by environmental conditions. The results of our study demonstrate this assessment, because of the nitrogen and sulphur content identified in *Acer platanoides*, and *Juglas regia* leaves, in condition of their presence in high traffic area, which is an important generator of pollution with above mentioned elements.

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