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Original Article

Study of the Synergic Action of Sulphur Dioxide and Nitrogen Oxides from Environmental Upon Urban Tree Species

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Abstract

Nitrogen and sulphur pollution in areas characterized by heavy traffic is an important challenge for all those invested with responsibilities in local The identification of tree species used in urban areas as ornamental trees, that have particular behaviour against different heavy metal pollution is of great importance The aim of our study was to quantify the sulphur and nitrogen accumulation in tree species from a heavy traffic area of Cluj - Napoca, Aurel Vlaicu street, in order to emphasize their synergic action with not desirable effects upon environment. The leave samples were collected weekly during spring and summer of 2010, sulfur and nitrogen were detemined in the Laboratories of the Department of Environmental and Plant Protection from the Faculty of Agriculture of the UASVM Cluj - Napoca, with Perkin - Elmer Atomic Absorption Spectrometer with flame and graphite furnace, Analyst 800. Sulphur and nitrogen accumulations recorded the biggest values in *Betula pendula*, and smallest in *Aesculum hippocastanum*. The strong interaction betwen the concentration of the nitrogen oxides and sulphur dioxide from the environemntal air and sulphur and nitrogen concentrations in *Betula pendula* leaves (R = 0.997) demonstrate their synergic action.

Keywords: multiregression analyze, Boxplot diagram, pollutants accumulation, foliar coverage

1. Introduction

The nitrogen and sulphur pollution in urban agglomerations is a continuous problem for authorities, scientist, and entire community. Lots of toxic effects of pollutants are difficult to identify, because a large part of them act in synergic between them and with other stressing biotic or abiotic factors. Thus, the most important problem is that of synergic action of these compounds that determine a large amount of accumulation in vegetation even their concentrations treated apart are not harmful.

The aim of our study was to quantify the sulphur and nitrogen accumulation in tree species from a heavy traffic area of Cluj - Napoca, Aurel Vlaicu street, in order to emphasize their synergic action with not desirable effects upon environment.

2. Material and Method

The monitored trees were located on Aurel Vlaicu Street from Cluj - Napoca, which is a very populated area with intense traffic. The analyze material, represented by the foliar coverage of the following five tree species *Pinus nigra, Aesculus hippocastanum, Betula pendula, Picea pungens* var. *glauca* and *Tilia cordata,* was collected weekly during spring and summer of 2010. The nitrogen and sulphur concentrations from tree leaves were determined in the Laboratory of the Department of

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Environmental and Plant Protection from the Faculty of Agriculture of the University of Agricultural Sciences and Veterinary Medicine Cluj - Napoca, with Perkin - Elmer Atomic Absorption Spectrometer with flame and graphite furnace, Analyst 800. The environmental sulphur dioxide and nitrogen oxides concentrations, in studied area, were obtained from the regional Agencies of Environmental Protection Cluj - Napoca.

The programme Statistica v.7.0 for Windows was used for data processing. Multiple regression analyze was applied together with Boxplot diagrams and plot areas graphics in order to emphasize the synergic effect of concerned elements.

3.Results and Discussions

The study of the Boxplot diagram (figs. 1 and 2) of sulphur and nitrogen accumulations shows similar results, with a normal distribution in all analyzed tree species, for both pollutant elements, but with biggest accumulation in *Betula pendula*, and smallest in *Aesculum hippocastanum* (figs. 1 and 2).

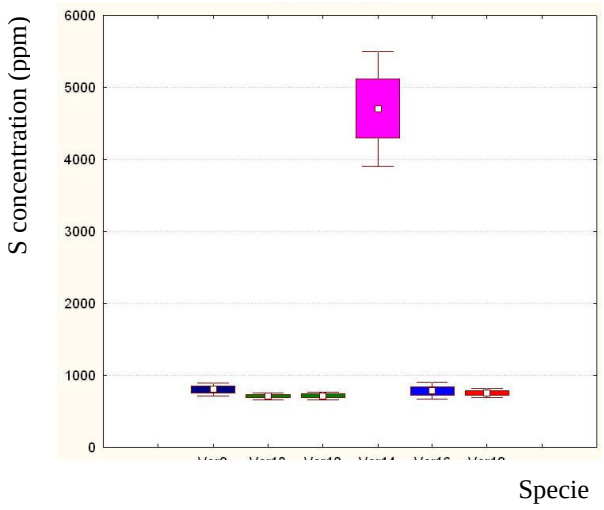

Figure 1. The distribution of sulphur in leaves of the studied trees

The analyze of the synergic action of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) reveals their synergic action (figs. 3 and 4).

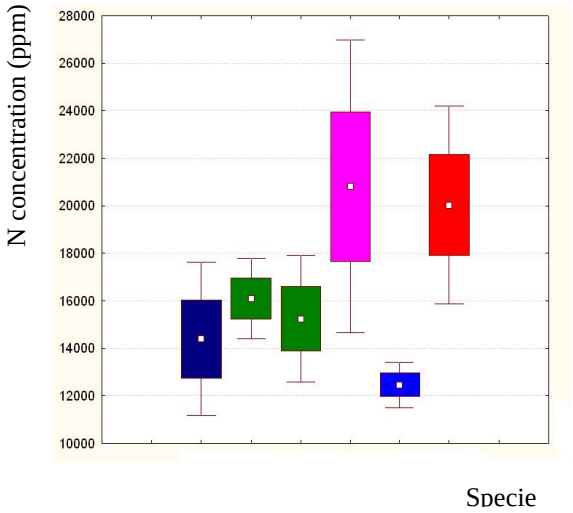

Figure 2. The distribution of nitrogen in leaves of the studied trees

The biggest multiple correlation coefficient was reported in *Betula pendula* (R = 0.997).

The aspect of the concerned tree leaves (fig. 5) confirm the strong interaction betwen the concentration of the nitrogen oxides and sulphur dioxide from the environemntal air, that act in synergy determining a higher nitrogen and sulphur accumulation and tissue lesions. These interrelationships explains the high sulphur and nitrogen content in some species with enhanced accumulation capacity for these elements (e.g. *Betula pendula*), even the sulphur dioxide and nitrogen oxids do not exceed the normal limits in environmental air, as reported by the N - V Regional Environmental Agency [6].

Figure 5. Section through *Bertula pendula* tissue

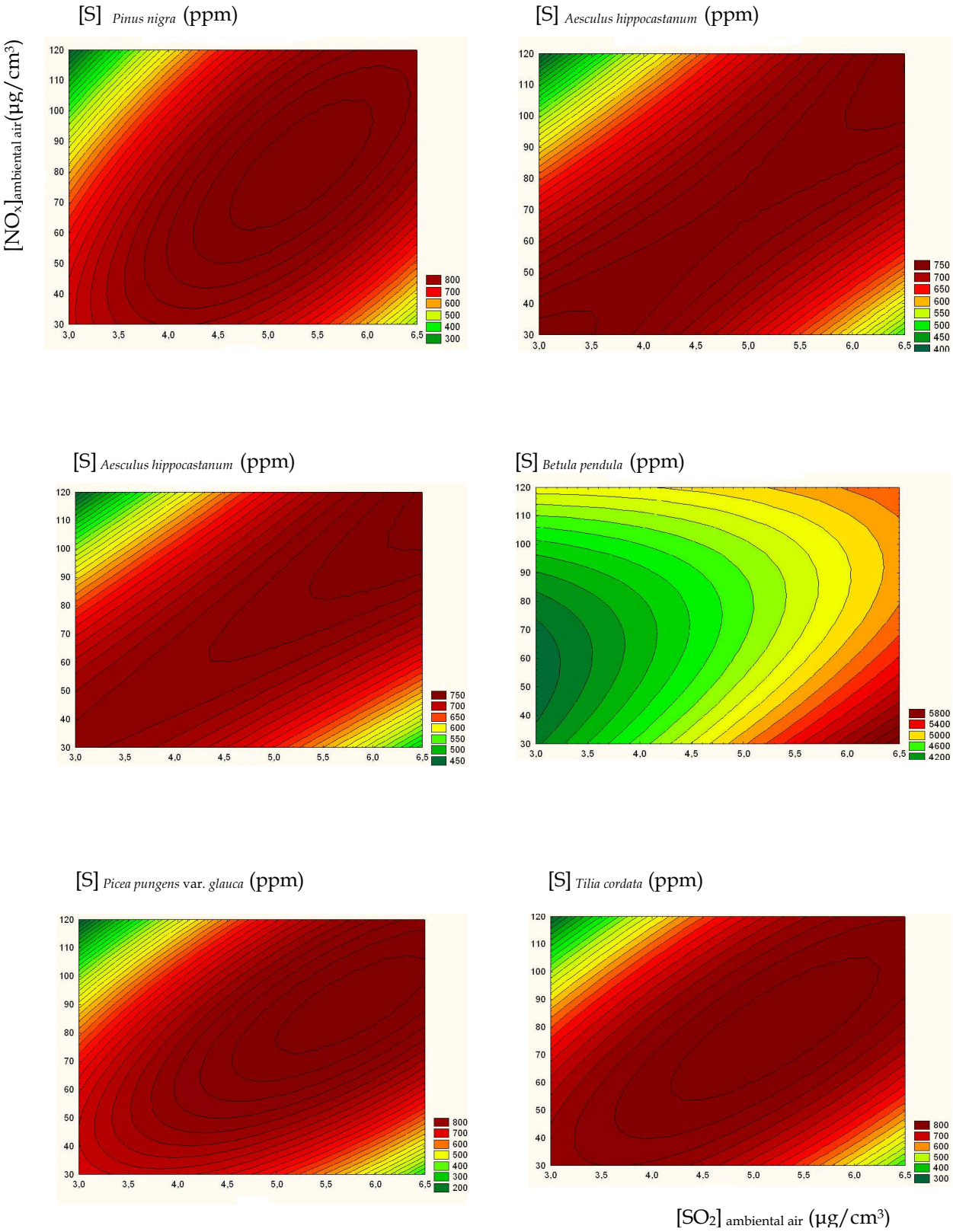

Figure 3. The interrelations between NO_x andSO_2 from environmental air and sulphur content from the leaves of the studied tree species

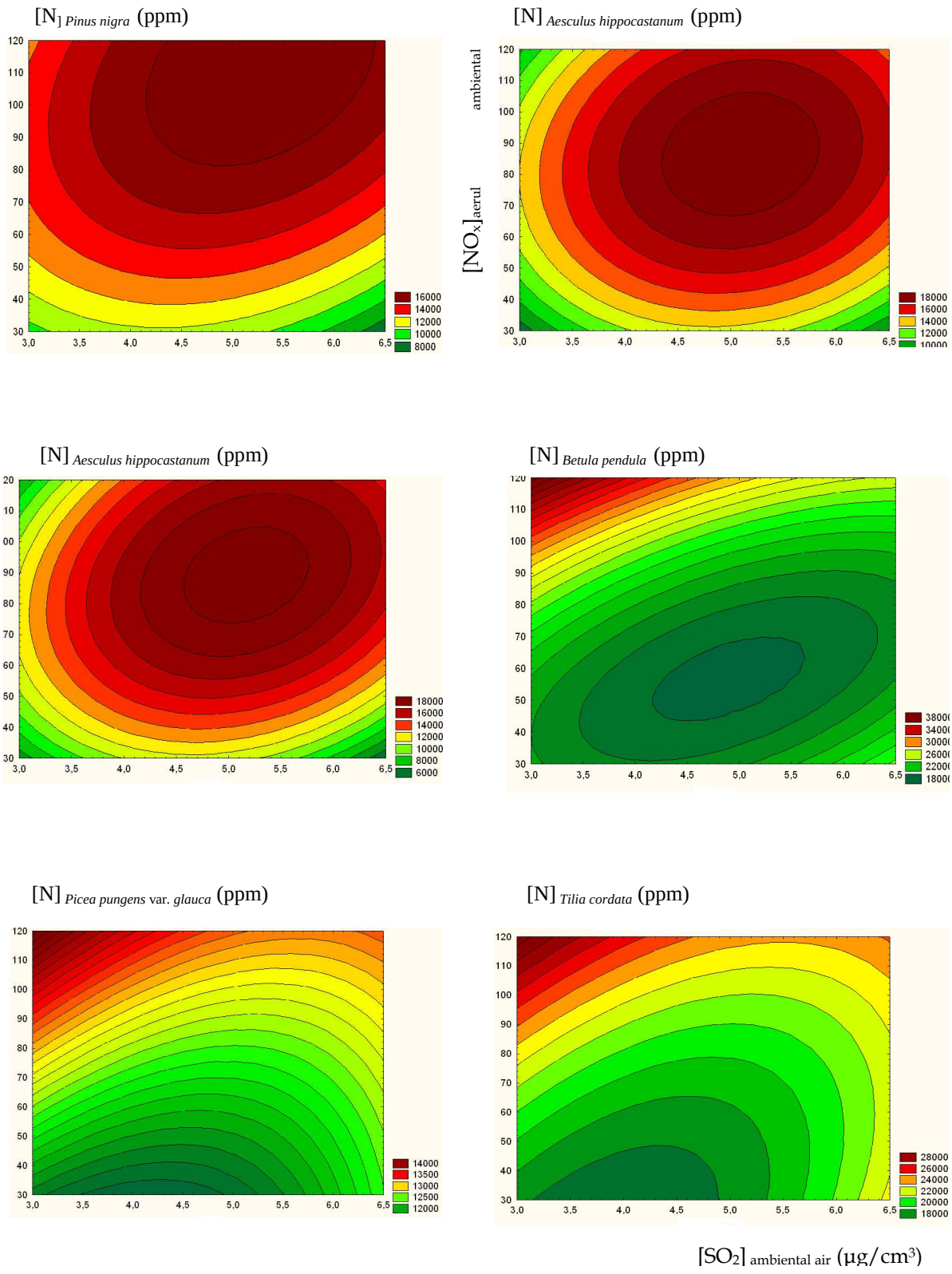

Figure 4. The interrelations between NO_x andSO_2 from environmental air and nitrogen content from the leaves of the studied tree species

Table 8. The interrelationship between SO_2, NO_x concentration in environmental air, S and N from the leaves of the analzyed tree species, emphasized by the multiple regression analyze

Tree specie	p	R	R^2
Pinus nigra	0.526		
	0.064	0.938	0.881
	0.127		
	0.125		
Regression line: $[S]_{P.\ nigra} = - 286.152 + 1.092[SO_2] - 3.231[NO_x] + 3.199[N]_{P.\ nigra}$			
Aesculus hippocastanum 1	0.306		
	0.707	0.493	0.244
	0.862		
	0.688		
Regression line: $[S]_{A.\ hippocastanum\ 1} = 497.165 + 0.283[SO_2] – 0.171[NO_x] + 0.419[N]_{A.\ hippocastanum\ 1}$			
Aesculus hippocastanum 2	0.175		
	0.816	0.643	0.413
	0.771		
	0.513		
Regression line: $[S]_{A.\ hippocastanum\ 2} = 4981.647 + 0.154[SO_2] – 0.332[NO_x] + 0.819[N]_{A.\ hippocastanum\ 2}$			
Betula pendula	0.052		
	0.003	0.997	0.994
	0.027		
	0.026		
Regression line: $[S]_{B.\ pendula} = 1266.829 + 1.131[SO_2] – 0.834[NO_x] + 0.831[N]_{B.\ pendula}$			
Specia arboricolă/Tree specie	p	R	R^2
Picea pungens var. *glauca*	0.910		
	0.481	0.582	0.339
	0.979		
	0.977		
Regression line: $[S]_{P.\ pungens\ v.\ glauca} = 496.576 + 0521[SO_2] – 0.084[NO_x] + 0.091[N]_{P.\ pungens\ v.\ glauca}$			
Tilia cordata	0.170		
	0.479	0.564	0.319
	0.527		
	0.519		
Regression line: $[S]_{T.\ cordata} = 101.574 + 0.591[SO_2] + 1.887[NO_x] – 1.998[N]_{T.\ cordata}$			

4.Conclusions

Normal distribution in all analyzed tree species was reported for sulphur and nitrogen accumulations, with biggest values in *Betula pendula*, and smallest in *Aesculum hippocastanum*. The strong interaction betwen the concentration of the nitrogen oxides and sulphur dioxide from the environemntal air and sulphur and nitrogen concentrations in *Betula pendula* leaves (R = 0.997) demonstrate their synergic action that determine biggest accumulations also emphasized by tissue lesions. The big value of the determination coefficient (R^2 = 0.994) confirm ther repeatability of the results.

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