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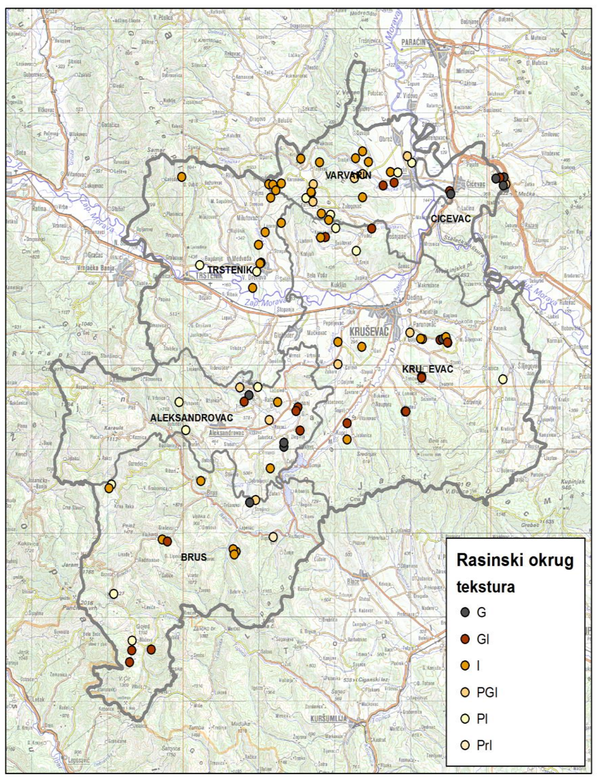
Content of heavy metals in arable plots of Rasina District

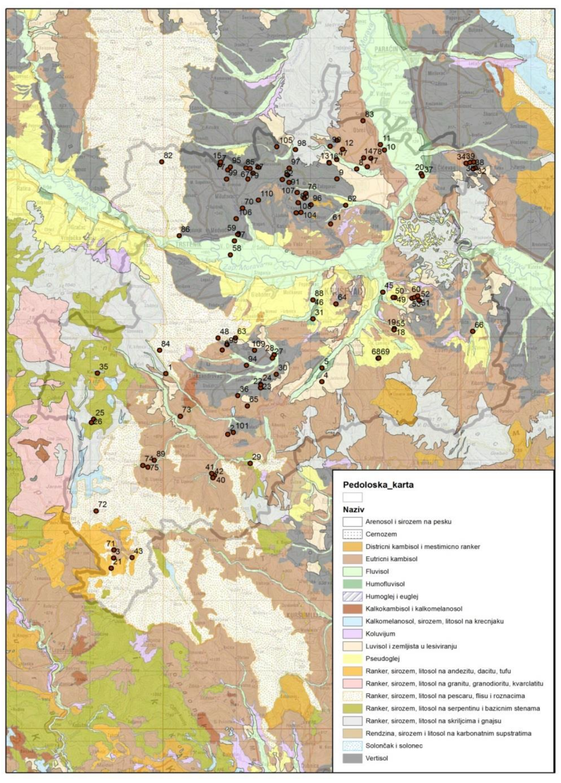
Biljana Sikirić, Olivera Stajković-Srbinović, Darko Jaramaz, Nikola Koković, Zoran Dinić, Vesna Mrvić

Institute of Soil Science, Belgrade, Serbia

Introduction

Rasina district is located in the central part of Serbia, on an area of 2,667 km2 and includes the municipalities: Aleksandrovac, Brus, Varvarin, Kruševac, Trstenik and Ćićevac. This district is recognizable as a very developed agricultural area, in which the following stand out: the valley of the West and Great Morava, the Ibar and Rasina valleys, that is, the Kruševac and Kraljevo valleys, then the famous Aleksandrovac parish or vineyards. The area of the municipality of Brus also covers the slopes of Kopaonik. In previous years, systematic fertility control including the basic agrochemical parameters of fertility was performed. The aim of the research was to improve the existing fertility control system through additional soil examinations (content of total and accessible forms of microelements and heavy metals) of certain cadastral parcels of registered agricultural holdings in Rasina district. Only on the basis of the complete examination good recommendations for the appropriate crops cultivation, as well as recommend adequate agrotechnical and ameliorative measures (calcification, application of organic fertilizers, foliar micronutrients) can be given. These measures primarily achieve the improvement of soil quality and maximum use of land potential, but also open the possibility of achieving high yields and product quality. The special significance of these results is reflected in the consideration of the possibilities of organic production on farms.





Tab. 1- Total content of heavy metals and harmful elements in soils of the municipality of Rasina District

Parameter	As	Cd	Cr	Co	Cu	Ni	Pb	Zn	Fe	Mn
Mean	9,2	0,32	97	23,6	37,1	121	34,5	81	27601	970
St. deviation	4,2	0,09	96	12,7	25,8	208	17,5	23	5994	276
Minimum	1,0	0,17	21	8,3	7,1	24	11	32	10913	356
Maximum	23,9	0,68	663	119	199	1996	104	156	50342	1660
% of samples with values > MDK	-	-	20		3	30	-	-	-	-

Tab.2- Available content of heavy metals and harmful elements in soils of the municipality of Rasina District

Parameter	Cd	Cr	Co	Cu	Ni	Pb	Zn	Fe	Mn	B
Mean	0,08	0,02	0,36	4,3	5,5	3,8	2,2	67,5	57,1	0,59
St. deviation	0,03	0,02	0,30	6,5	8,4	2,7	1,7	38,3	30,2	0,32
Minimum	0,01	0,00	0,05	0,7	0,9	0,4	0,2	12	14	0,00
Maximum	0,18	0,07	2,02	44,4	62,5	12,2	8,5	164	210	1,59
% of samples with values > MDK	-	-	-		9%	4%				

Results and Discussion

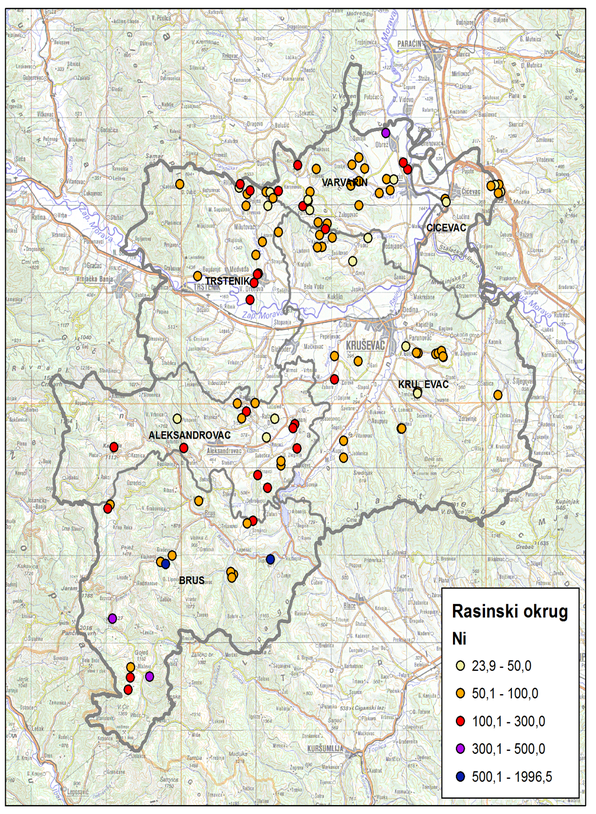
Regarding the microelements and heavy metals content, a significant part of the examined cadastral parcels has regular values for unpolluted agricultural lands. The potentially harmful content of total nickel and chromium (30% and 20% of samples above 100 mg/kg, respectively), which is primarily of geochemical origin, was detected. There are higher concentrations of available Ni in 9% of samples, mostly on mountainous soils (municipalities Brus and Varvarin). In vertisol soils (under vineyards) and in alluvial soils (under vegetable crops), where there is intensive protection with copper preparations, increased concentrations of total and available Cu (10% of samples had values above the maximum allowed) were observed, but below the limit when harmful effects on the plant occur. In the further period the preparats without cooper should be used. The Pb content above the maximum allowed value was found in only one sample. With the increase of the total Pb, the available ones also increase (in 4% of the samples), and the exact origin of the increased concentrations should be established by the next research. The low content of individual biogenic microelements was detected, primarily Zn (30% of samples) and B (50% of samples).

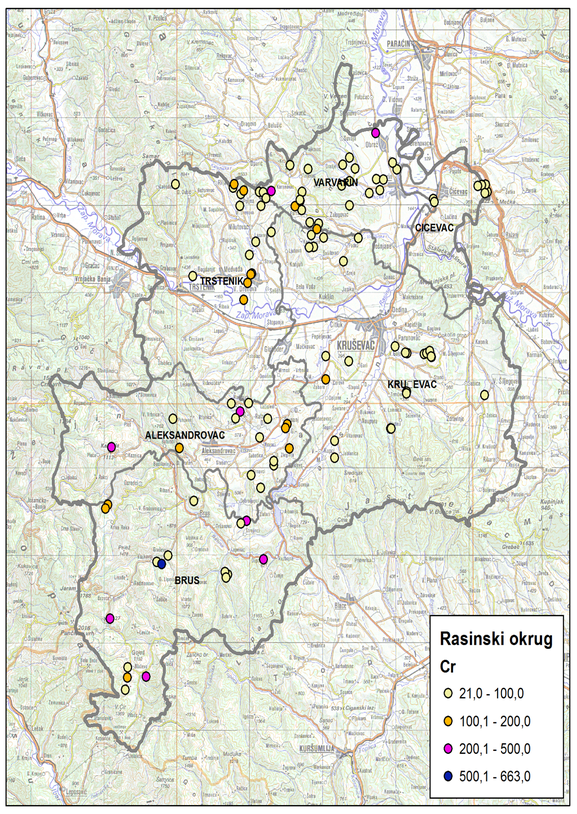
The increased contents of microelements and heavy metals, which were established by research, can be effectively reduced by phosphatization, humization, and especially calcification. Locations with values of total forms above the MAC, and with increased content of accessible elements, should be included in the system of continuous monitoring, in order to constantly monitor and determine with greater certainty the potentially harmful impact of increased pollutant content on the environment. In case their negative impact is determined, appropriate remediation measures or changes in the way of use would be proposed.

Materials and Methods

One composite sample was taken from each of the 110 examined cadastral parcels from a depth of 0-30 cm. In the soil samples total and accessible forms of microelements and heavy metals were determined. Total form content of heavy metals, i.e. harmful elements: arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), iron (Fe), manganese (Mn) were determined by cooking with HNO_3 and H_2O_2 and spectrometric determination on ICP, and the contents of the available forms of heavy metals, i.e. harmful elements: cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), iron (Fe), manganese (Mn), and boron (B) were determined by extraction in DTPA and spectrometric identification on ICP. The criteria for the assessment of soil contamination with these elements were maximum admissible concentrations (MAC) in agricultural soils, according to the Regulation (SG RS 11/19).

The data was processed with basic descriptive statistics and the correlation method. Cartographic data was processed using mapping software GIS Arc View 8.3.





In locations where a deficiency of microelements has been established, microfertilizers should be applied foliarly or over the soil.

It is considered that this research should be expanded in the coming period by a more detailed study of pedological and geological characteristics of the area and composition of plant material, in order to more fully consider the possibilities of intensive agricultural production and recommend agrotechnical measures to increase soil fertility. The research can be extended to other districts.