ANNALS OF THE FACULTY OF ENGINEERING HUNEDOARA
2006, Tome IV, Fascicole 3, (ISSN 1584 – 2673)
FACULTY OF ENGINEERING HUNEDOARA,
5, REVOLUTIEI, 331128, HUNEDOARA

VOJVODINA SOIL FERTILITY CONTROL RESULTS CONSIDERING LAND USE

Jovica VASIN, Petar SEKULIĆ, Igor KURJAČKI

INSTITUTE OF FIELD AND VEGETABLE CROPS NOVI SAD, SERBIA

Abstract
The System of Soil Fertility Control covers all factors determining soil fertility as well as the measures for soil fertility improvement. Its objective is to ensure high and stable crop production taking into account production economy and environmental protection. In the period of last 15 years, the System was insufficiently exploited in the agricultural production. With the intention of refreshing the interest of the professional public in soil analysis, an integral element of the System, a campaign has been conducted in the course of 2002 and 2003 in which soil analyses were done free of charge for private farmers.
More than 27,000 soil samples were analyzed in the two years. Soil analyses covered pH and the contents of $CaCO_3$, humus, available phosphorus and available potassium. Over 80% of the samples came from production fields, about 10% were from orchards and the remaining part were from greenhouses, vineyards, pastures, etc.
Most of the samples belonged to neutral and slightly alkaline soils (about 90%). Although most of the samples were rich in humus, it remains as a matter of concern that almost one half of the samples were poor in humus. Roughly a sixth of the samples had low phosphorus contents. On the other side, about 10% of the samples had high or even toxic phosphorus contents. This situation was encountered in greenhouses and fields devoted to intensive vegetable production. The obtained potassium contents were within the range of optimum values for agricultural production. Soil analysis makes room for a more economic application of fertilizers in agricultural production.
Key words:
Soil Fertility and Fertilizer Use Control System, the Vojvodina Province, private sector, land use

1. INTRODUCTION

Scientific basis of the Soil Fertility and Fertilizer Use Control System was presented to the public at the 6th Congress of the Soil Science Society of Yugoslavia (Congress Resolution, 1980). In 1985, the Assembly of the Autonomous Province of Vojvodina passed the Agricultural Land Use Act, which codified the dicta of the System.

The System encompasses the monitoring and control of all factors determining soil fertility and fertilizer action, i.e., it determines how the soil affects the growth, development and yield of crops and which measures must be undertaken to ensure high, stable and economic yields and adequate protection of the biosphere (Manojlović, 1986).

On introduction, the System performed well, particularly in the so-called public sector of agriculture (Manojlović, 1986). During last 15 years, however, the System gradually fell out of use, first of all due to the protracted and exhausting economic crisis and then due to the war devastations. Fertilization, a vital agrotechnical practice, was drastically reduced or altogether omitted, leading to a reduction of

the natural soil fertility. A solution has been seen in strengthening the private sector. If persuaded to use fertilizer formulations cost-efficiently and in accordance with actual soil fertility status and crop requirements, the private sector may be realistically expected to increase crop yields maintaining at the same time maximum production economy and a satisfactory level of protection of the biosphere.

Wishing to reinstate the monitoring of soil fertility status, an important element of the System, the Secretariat of Agriculture of the Vojvodina Province and the Institute of Field and Vegetable Crops jointly coordinated in 2002 a campaign of soil analyzing free of charge for private farmers from the Province.

2. MATERIALS AND METHODS

The campaign started with press releases in 2002 and 2003 in which farmers were informed of the importance of soil sampling and the technique of soil sampling. Farmers were instructed how to take samples. Samples were sent to the Institute of Field and Vegetable Crops or to the network of regional agricultural stations in Vojvodina Province.

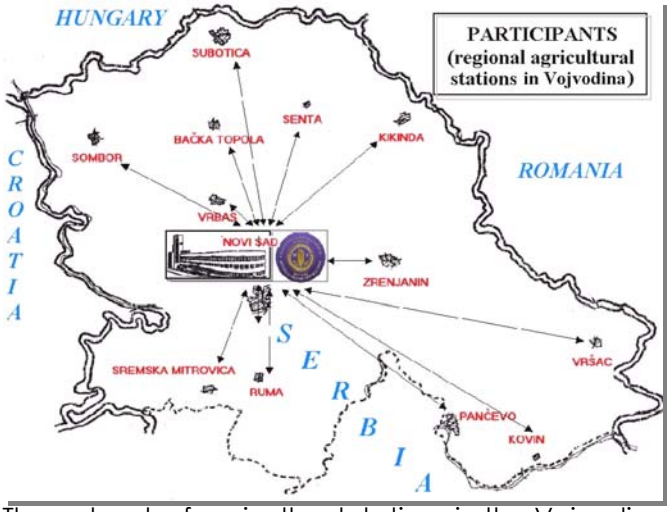

Figure 1 - The network of agricultural stations in the Vojvodina Province

Soil of up to 30cm depth has been sampled**.** More than 27.000 samples were collected and analyzed. Out of these 86.5 % samples have been taken from arable fields (field – outdoor production of field and vegetable crops), 9.8 % from field lots under perennial plantation (fruit and vine), and 3.6 % samples from indoor production (greenhouses and glasshouses).

Laboratory analyses included the following parameters of soil fertility:

- pH value in soil suspension with KCl, determined potentiometrically;
- humus content – by the method of Tjurin;
- available phosphorus (extraction with ammonium lactate) - AL method; phosphorus content by the blue method in a spectrophotometer;
- available potassium (extraction with ammonium lactate) - AL method; potassium content determined flame photometrically.

3. RESULTS

Soil reaction analyses results show that most samples belong to neutral to slightly alkaline class of soil. The percentage of samples with extreme values of soil reaction was negligible.This is the result of pedogenesis, i.e. parent material which is loess for most soils in Vojvodina. Reducing pH value to neutral, which is the most favourable for growing majority of crops can be achieved by application of physiologically acid fertilizers such as urea, amonium-nitrate, etc. whose repeated application over a period of time tend to reduce the soil's pH (Bogdanović, D. et al., 1993).

Table 1 – Soil samples part in different classes considering soil reaction in relation to land use (%)

pH value in 1 M KCl	SOIL CLASS	Arable	Perennial plantation		Indoor production
			0-30 cm	30-60 cm	
< 4,5	very acid	1,40	1,87	1,86	0,00
4,51-5,50	acid	3,87	5,99	7,12	0,94
5,51-6,50	slightly acid	9,78	9,61	9,75	13,67
6,51-7,20	neutral	43,53	34,33	29,72	54,30
7,21-8,20	slightly alkaline	41,39	46,44	48,45	31,09
>8,20	alkaline	0,02	1,76	3,10	0,00

Table 2 – Soil samples part in different classes considering humus content in relation to land use (%)

Humus content %	SOIL CLASS	Arable	Perennial plantation		Indoor production
			0-30 cm	30-60 cm	
< 1,00	very slightly humic	0,41	14,36	24,61	0,56
1,01-3,00	slightly humic	41,60	58,30	59,13	35,39
3,01-5,00	humic	56,99	25,97	15,02	55,06
5,01-10,00	strongly humic	1,00	1,37	1,24	8,99

Tested soil samples dominantly belong to the class of humic soils (table 2). The land from the private sector had a somewhat higher humus content than the land from the public sector (Ćirović et al., 1993). With arable fields percentage of slightly humic soils is worrying where it is necessary to enhance organic fertilization. Because of dwindling numbers of domestic animals, manure is steadily becoming more and more scarce. Simultaneously, the plowing under of harvest residues such as wheat straw, cornstalks, sunflower stems and sugarbeet tops and leaves gains importance.

Higher percentage of soil class with higher humus content from indoor samples is the result of choice of fertile soil for construction of these facilities and bringing fertile material for growing (peat, etc.).

Table 3 – Soil samples part in different classes considering easily available phosphorus content in relation to land use (%)

pH value in 1 M KCl	SOIL CLASS	Arable	Perennial plantation		Indoor production
			0-30 cm	30-60 cm	
< 5,00	very poor	3,41	7,74	16,41	0,00
5,01-10,00	poor	12,16	16,73	22,91	1,31
10,01-15,00	average	19,15	17,35	15,79	3,00
15,01-25,00	optimal	33,59	19,98	19,04	10,49
25,01-50,00	high	21,45	20,72	14,24	16,85
50,01-100,00	hazardous content	7,56	11,74	7,43	26,59
>100,01	toxic content	2,68	5,74	4,18	41,76

Considerable diversity considering easily available phosphorus is the result of incorrect fertilization with this macronutrient element. With arable fields and perennial plantations the percentage of classes with content below optimal (more than a third) has important reduction effect on grown crops yield. These fields require meliorative fertilization.

With indoor samples, however, there was a high procentage of classes with hazardous and even toxic content of phosphorus. These extremely high contents are due to the relatively small size of these fields, high profitability of such production and evident lack of experience among the farmers. Phosphorus excess leads to immobilization of ion uptake and transport of certain biogenic microelements, and besides this reduces nutritive and technological quality of the product.

Table 4 – Soil samples part in different classes considering easily available potassium content in relation to land use (%)

pH value in 1 M KCl	SOIL CLASS	Arable	Perennial plantation		Indoor production
			0-30 cm	30-60 cm	
< 5,00	very poor	0,02	0,62	0,93	0,00
5,01-10,00	poor	0,85	10,74	17,96	0,37
10,01-15,00	average	4,52	16,60	20,12	3,75
15,01-25,00	optimal	41,00	32,58	34,21	17,60
25,01-50,00	high	47,67	29,09	20,90	34,64
50,01-100,00	hazardous content	5,63	8,75	3,87	27,34
>100,01	toxic content	0,31	1,62	2,01	16,29

The case of easily available potassium is more favourable. The percentage of classes with optimal and high content is dominant, which opens the possibility of important racionalization in fertilizing with easly available potassium. These results are yet another indication of the importance of soil development, since most of the soils of the Vojvodina Province had formed on a native substrate rich in potassium.

Table 5 – Average, minimum and maximum value of tested parametres of soil fertility

Land use		Arable	Perennial plantation		Indoor production
			0-30 cm	30-60 cm	
pH in KCl	average	6,66	7,01	7,04	7,00
	min	3,78	4,17	4,05	4,86
	max	7,62	8,50	8,67	8,13
Humus %	average	3,01	2,30	1,87	3,44
	min	0,03	0,01	0,01	0,71
	max	6,85	5,94	6,47	8,40
AL-P_2O_5 mg/100g	average	27,09	34,36	26,90	108,88
	min	0,10	1,70	0,72	6,30
	max	486,00	543,00	469,00	498,20
AL-K_2O mg/100g	average	28,43	27,67	23,07	57,71
	min	5,00	4,50	4,10	8,90
	max	321,20	179,50	195,80	197,00

The average values of the analyzed parameters show that the soils of the Vojvodina Province are favorable for an intensive agricultural production

From table 5 it can be seen that there is a large scope between minimal and maximal values of the tested parametres, which primarily points out to a high influence of antropogenous factor on soil fertility.

4. CONCLUSIONS

Based on the results from soil sample analyses in private properties under different land uses, it can be concluded that:

- tested soil fertility parametres have diverse values which a result of pedogenesis and at a larger scale the influence of antropogenous factor
- tested soils are dominantly of neutral to slightly alkaline reaction which shows that more physiologically acid mineral fertilizers should be used.
- humus content in soil for most land uses is satisfactory, with additional organic fertilization and turning harvest residue.
- within one land use (eg. arable fields) there is a large diversity of the results for macronutrients content (phosphorus and potassium), as well as among different land uses (high values from indoor production)

All stated shows that it is necessary to implement Soil Fertility Control System at each production field lot, so as to achieve correct fertilization based on analyses results and land use, i.e. growing of different crops.

REFERENCES

[1.] BOGDANOVIĆ D., UBAVIĆ M., DOZET D.: *Hemijska svojstva i obezbeđenost zemljišta Vojvodine neophodnim makroelementima. Teški metali i pesticidi u zemljištu (Kastori R.,ur.)*, Institut za ratarstvo i povrtarstvo Novi Sad, str 197-215, Novi Sad, 1993.

[2.] ĆIROVIĆ M., SEKULIĆ P., HADŽIĆ V., 1993: *Opšte stanje plodnosti vojvođanskog černozema u zavisnosti od tipa vlasništva. Teški metali i pesticidi u zemljištu (Kastori R., ur.)*, Institut za ratarstvo i povrtarstvo Novi Sad, str 291-298.

[3.] LAZIĆ, B., ĐUROVKA, M., MARKOVIĆ, V., ILIĆ, Ž.(1998): *Povrtarstvo*. Univerzitet u Novom Sadu, Poljoprivredni fakultet, Novi Sad.

[4.] MANOJLOVIĆ, S.(1986): *Sistem kontrole plodnosti zemljišta i upotrebe đubriva u SAP Vojvodini – od naučnih istraživanja, preko razvojnih istraživanja do funkcionisanja u poljorivrednoj proizvodnji Vojvodine*. Zbornik radova Pokrajinskog komiteta za nauku i informatiku, knjiga broj 18, Novi Sad, pp. 123-127.

[5.] SEKULIĆ, P., KURJAČKI, I., VASIN, J.(2003): *Getting Vojvodina Province Farmers Involved in the Soil Fertility Control System*. International Conference "Agricultural Economics, Rural Development and Informatics in the New Millennium (AVA)", CD ROM, Debrecen.