INDICATOR FOR THE EVALUATION OF THE SOILS FERTILITY LEVEL

INDICATOR PENTRU EVALUAREA NIVELULUI DE FERTILITATE A SOLURILOR

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Abstract. *By quantized summation of the main properties: texture, reaction, humus content, total nitrogen content or nitrogen index value (NI) and phosphorus and potassium contents in mobile forms, soluble in ammonium acetate-lactate solution at pH 3.7, we could make soils fertility appreciation. The value obtained through balanced arithmetic average calculation, or other balanced parameter of grouping centre, turned into an number of points, is appreciate by a scale from 0 to 30. This scale is designating the soil fertility levels, from very low to very high, passing through intermediary levels as low, medium and high. The evaluation of soil fertility is possible after analyzing of soil trials sampled usually from organic horizon. For soil fertility evaluation in case of orchard, grapevine, shrubbery, and other plants with profound rooting, mineral horizons could be taking into account.*

Rezumat. *Aprecierea fertilității solurilor se face prin insumarea cuantificată a principalelor însuşiri: textura, reacția, conținutul de humus, conținutul total de azot sau valoarea indicelui de azot (IN) şi conținuturile în forme mobile de P şi K, solubile în soluția de acetat-lactat de amoniu la pH 3,7. Valoarea obținută prin calculul mediei aritmetice ponderate sau a altui parametru ponderat al centrului de grupare, transformată în număr de puncte, se apreciază după o scară de la 0 la 30, care desemnează nivelele de fertilitate, de la foarte scăzut la foarte ridicat, cu trepte intermediare de: scăzut, ridicat şi moderat. Evaluarea fertilității se face în urma analizării probelor de sol recoltate din orizonturile organice. În cazul aprecierii fertilității pentru pomi, viță de vie, arbuşti fructiferi şi alte plante cu înrădăcinare profundă se pot lua în considerație şi orizonturile minerale.*

The fertility represents essential features of the soil, which contributes, obviously to maintaining the life on earth. This feature is determined by many factors of physical, chemical and biological nature, which give an incontestable complexity.

For this reason, the fertility was and is see from different viewpoints, by Ştefanic and his coworkers(2006), divided them in three agronomic categories: agronomical, agrochemical and biological. The first group contained the definitions and the ideas which binding the fertility of productivity, considering them widely synonyms.

In the second group appear definitions and concepts which binds the fertility of the soil capacity to put water, nutritive substances and elements for plants needs at optimum level for the whole vegetation period, to assure proper conditions to develop and superior harvests from quantitative, qualitative, certainly and stable viewpoints.

Finally, the third category includes the definitions and biological processes, which contribute to the achievement in soil of completely necessary conditions for the satisfaction of optimum nutrition and develop needs of plants. In this case Ştefanic evolve some biological indicators (Ştefanic şi colab., 2006), used to the outline the synthetic indicator of soil fertility. This represent the sum of other indicators, resulted from many biological, chemical, biochemical (enzymatic) determinations. Author does not establish any soil fertility levels.

In order to create maps at large scale for soil vulnerability, specific for urban soils, especially those with horticultural use, was needed a simple procedure assessment for soil fertility that can be used in any agrochemical lab. In this respect, was developed a new indicator for soil fertility, which comprises chemical and physical properties of the soil, which are considered to indirectly mirror most of the other physical, chemical and biological features of the soil that sums the fertility of the soil.

MATERIAL AND METHODS

Soil fertility assessment is made by quantified sum of six specific indicators, one is physical – texture- and five are chemical: pH, humus content, total nitrogen or nitrogen indicator (NI), the content of the mobile forms of P (PAL) and K (KAL) which can be dilluted in ammonium lactate acetate (AL, pH=7,0).These features, quantified through content or pH value, was transform in content or reaction class according to methodology of pedological studies (Florea si colab., 1987).

RESULTS AND DISCUSSIONS

Each chemical substances and elements envisaged, of texture or reaction received a score from 1 to 5. Minimum score is a lower field or unfavorable content, and the maximum score displays a maximum field or favorable (tables 1 to 4). By summing the scores given for each property of the analyzed sample, it will be obtained a final score that will mark the level of fertility of that soil sample. For each genetic horizon, or each geometrical horizon the scores are calculated. Soil fertility is usually assessed for the organic horizon and/or for the transition horizon towards the mineral one. For plants with deep roots and for the soils that are planted with fruit trees, vineyard and other alike plants one can also take into account deeper mineral horizons. The final number of points for a soil is the weighted average of the points of each analyzed horizon, from organic ones or from entire soil profile. This weighted average value displays soil fertility after the cumulated points (table 5). Instead, weighted average can be taken into account other parameters of the grouping center like geometric average, median or module.

Table 1

The appreciation marks depending the textural class

Score	Clay <2μ %	Textural class
1	< 6 >45	Sand Clay
2	6 - 12	Sandy loam
3	32,1 – 45	Clay loam
4	12,1 - 20	Loamy sand
5	20,1 - 32	Loam

Table 2

The appreciation marks depending to the soil reaction

Score	pH_{H2O}	Reaction class
1	<3,5	Extremely acid
	3,6-5,0	Very powerful and powerful acid
	8,5-9,0	Moderate alkaline
	9,1-10,0	Powerful and very powerful alkaline
	>10,1	Extremely alkaline
2	5,1-5,8	Moderate acid
3	5,9-6,4	Weakly acid
	7,9-8,4	Weakly alkaline
4	6,5-6,8	Weakly acid
	7,3-7,8	Weakly alkaline
5	6,9-7,2	Neutral

Table 3

The appreciation marks depending to the humus content

Score	Humus content limits (%) depending on textural class						Content class
	N	U	S	L	T	A	
	Sand	Sandy loam	Loamy sand	Loam	Clay loam	Clay	
1	<0,2	<0,4	<0,5	<0,6	<0,8	<1	Extremely low
2	0,3-0,5	0,5-0,8	0,6-1,1	0,7-1,3	0,9-1,5	1,1-2,0	Very low
3	0,6-1,0	0,9-1,7	1,2-2,2	1,4-3,0	1,6-3,5	2,1-5,0	Low
4	1,1-2,0	1,8-4,0	2,3-5,5	3,1-6,5	3,6-8,0	5,1-10,0	Medium
5	2,1-5,0	4,1-7,0	5,6-8,5	6,6-10,5	8,1-12,5	10,1-16,0	High

Table 4

The appreciation marks depending to the macro elements content

Score	total N	IN	P_{AL}	K_{AL}	Content class
	%	-	$mg \cdot kg^{-1}$	$mg \cdot kg^{-1}$	
1	<0,100	<1,0	<8	<65	Very low
2	0,100-0,140	1,1-2,0	8,1-18	65,1-130	Low
3	0,141-0,270	2,1-3,0	18,1-36	130,1-200	Medium
4	0,271-0,600	3,1-4,0	36,1-72	200,1-300	High
5	>600	4,1-5,0	>72	>300	Very high

Table 5

The appreciation of fertility level according to the point's number

Accumulated points number	Fertility level significance
0-10	Very low
10,1-15	Low
15,1-20	Moderate
20,1-25	High
25,1-30	Very high

As an example of the proposed method were chosen samples from three soil types samples and these are: prespodic dystricambosol (PCep) from Stâna de Vale (jud. Bihor), albic stagnosol STal) from Recea-Baia Mare (jud. Maramureş) and cambic phaeozem (FZcb) from Drăgăneşti Vlaşca (jud. Teleorman).

The scores of those six physical and chemical properties for the organic horizons of those three types of soil are shown in the figure 1. One can notice contrasting differences between first two soil types (prespodic dystricambosol şi albic stagnosol) and higher marks obtained for the third one (cambic phaeozem). In fact even the weighted number of points for the organic horizons of those three types of soil are quite different and make that first two analyzed soils be classified with low fertility score, with 10.9 points (PCep), 14.3 points respectively (STal) and high 20.9 points (FZcb).

When the fertility score is calculated for the whole soil profile are obtain much lower scores. For the given examples the scores are: 9.86 for prespodic dystricambosol, 9.79 for albic stagnosol and 13.1 for cambic phaeozem, concluding that are very low levels of fertility for the first two and low for the third.

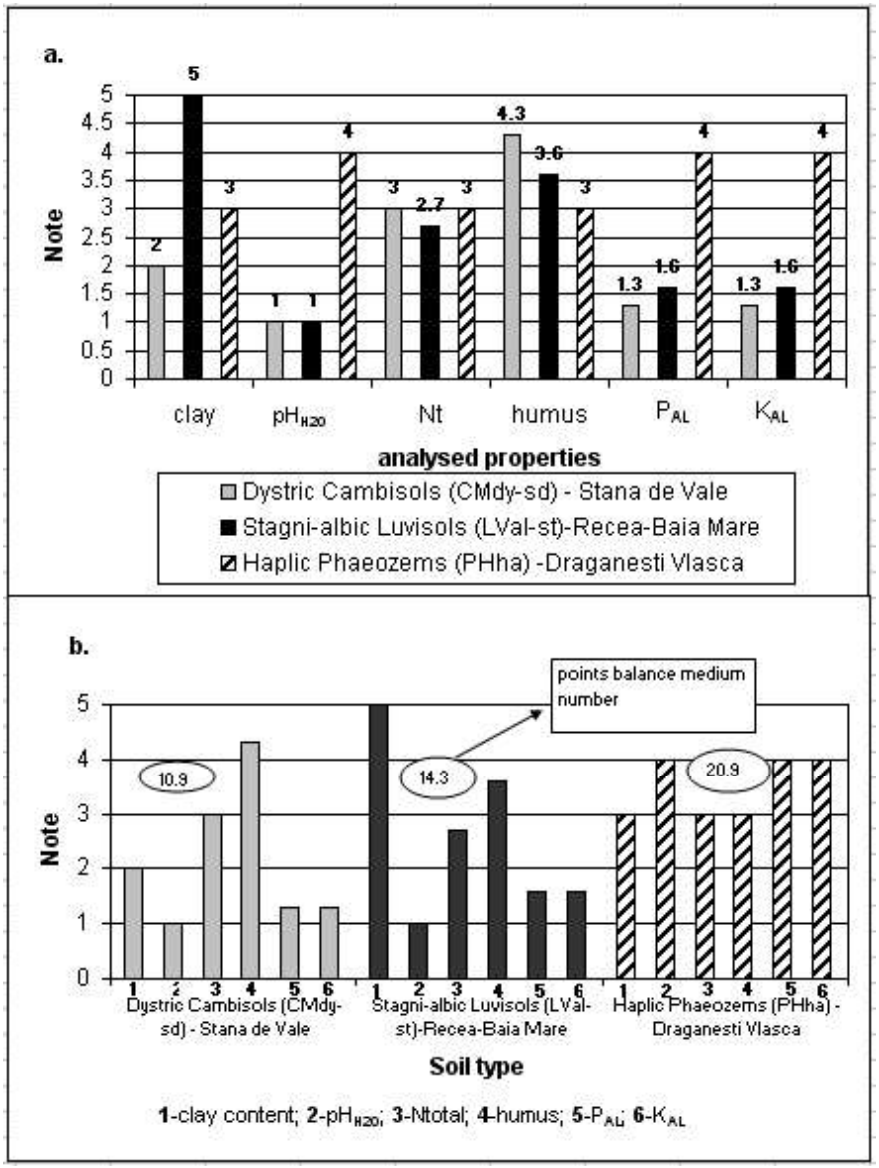

Fig. 1. The notes of main soil properties (organic horizons) group after the nature of analyses (a), after soil type (b) and points balance medium number for fertility appreciation

From many computations made for different types of soil we concluded that are few soils with high fertility and, in the field, in natural conditions was found no soil with high fertility score. Even in anthropic enhancement conditions with organic or chemical fertilizers they do not reach high levels of fertility, displayed in fertility scores.

CONCLUSIONS

For soil fertility assessment are used six specific indicators, one is physical – texture-, and five are of chemical origin: pH, humus content, total nitrogen of the nitrogen indices (IN) and the content of mobile forms of phosphorus (P_{AL}) and potassium (K_{AL}), that are soluble in ammonium acetate lactate (AL). Their values are estimated with scores from 1 to 5, as their grow in quantity or in availability to offer optimal conditions for plants growing and crop forming. By summing the obtained scores for each indicator, a final score is obtained, up to 30 points, which, at its turn is framed in a global class of fertility.

Fertility assessment is usually made by using analytical data of the organic horizons. For the soils used for fruit trees vineyard and alike plants with deep roots the fertility assessment can be made also by using mineral horizons.

REFERENCES

1. **Florea N., Bălăceanu V., Răuță C., Canarache A.** (coordinators), **1987 -** *Metodologia elaborării studiilor pedologice*, vol III. ICPA, Red. Prop. Tehn. Agricolă, Bucureşti
2. **Ştefanic Gh., Săndoiu D.I., Gheorghiță Niculina**, **2006** - *Biologia solurilor agricole*. Ed. Elisavaras, Bucureşti