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SOIL AGROCHEMICAL PROPERTIES ALONG THREE YEARS OF ECOLOGICAL *Salvia officinalis* CROPS

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Keywords: soil agrochemical properties, *Salvia officinalis*, ecological growth.

Abstract. Soil agrochemical properties were studied under several years of ecological *Salvia officinalis*. Soil reaction and the base saturation degree decrease along the experimental years. Slight increases of phosphorus contents were registered which is very important for Romania's soils and proves good efficiency of the organic fertilization. The organic fertilization efficiency is also supported by the mobile potassium increase. Except for the reaction and base saturation degree decrease, the ecological *Salvia officinalis* growth ensures the conservation of the soil's fertility properties and even improves the mobile phosphorus and potassium contents.

Introduction

Research has been carried out with medicinal herbs in the frame of a National project financed by CNCSIS through the Partnership Program. Ecologic and conventional technologies were applied. The project aimed to implement a standardization system of the vegetal raw materials which can be used in the cosmetic industry.

Savory, *Salvia officinalis*, is an aromatic herb, appreciated ever since antiquity. It is used in the cosmetics industry for the greasy or mixed complexion care, due to its antibiotic, anti-fungi, and astringent properties. It is also used in hair conditioners as it has a refreshing and reviving effect.

Savory contains phenol acids and enzymes with anti-oxidant properties. One of these enzymes is the superoxid-dismutaze, the anti-aging enzyme which corrects the flaws occurred during cellular multiplication, thus slowing down the tissues' degradation process. For that reason the plant is used in the cosmetics industry to prepare creams, soaps, and shampoos.

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1. Material and methods

The researches were carried out at Ungureni, Dâmbovița County. The dominant soil of the area is Red Preluvosol. The soil was fertilized with manure. The crops were placed in the field by the randomly arranged blocks method. Technical works were applied in the field: ploughing, harrowing, sowing, manual weeding. The soil was sampled three consecutive years, beginning after the first experimental year, before sowing.

The standardized analytical methodology was used on soil samples as follows: pH – potentiometric method, in 1:5 aqueous extract, with double glass and calomel electrode (SR 7184/13-2001 Soils. pH determination in aqueous and saline suspensions (mass/volume) and in saturated paste (Soluri. Determinarea pH-ului în suspensii apoase şi saline (masă/volum) şi în pastă la saturație)); organic matter – Walkley-Balck method, modified by Gogoaşă (STAS 7184/21-82 Soils. humus content determination (Soluri. Determinarea conținutului de humus)); total nitrogen –Kjeldahl Method (STAS 7184/2-85 Soils. Nitrogen content determination (Soluri. Determinarea conținutului de azot)); nitrate nitrogen (N-NO3) – potentiometric method, with ion-selective electrode; ammonium nitrogen (N-NH4) – distillation; mobile phosphorus and potassium – soluble in the ammonium acetate lactate at pH = 3.7 (STAS 7184/18-80 Soils. Determination of accessible and potentially accessible potassium content for plants (Soluri. Determinarea conținutului de potasiu accesibil şi potențial accesibil pentru plante) and STAS 7184/19-82 Soils. Determination of ammonium acetate-lactate soluble phosphorus (Soluri. Determinarea fosforului extractibil în acetat-lactat de amoniu)); cationic exchange properties (STAS 7184/12-88 Soils. Cationic exchange properties determination (Soluri. Determinarea proprietăților de schimb cationic)); mobile forms of micro elements (zinc, copper, iron, manganese) – extractible in the acetic acid – EDTA solution.

The analytical data were computed using Microsoft Excel for graphics and the STATIS Programme for data analysis.

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2.Results and discussions

The soil reaction decreased along the three experiment years from 6.98 to 6.14 in the soil upper layer (0-20 cm) and from 7.45 to 6.22 which means passing from the neutral-slightly alkaline class (6.9-8.4, according to Florea et al., 1987) to the slightly acid one (5.9-6.8, according to the same reference) (Fig.1). Although it is still a favorable domain for plant growth, this is a matter of concern regarding the soil fertility preservation under ecological crops.

The base saturation degree places the soils in the eubasic class (91-100%, Florea et al., 1987) at the beginning of the experiment and decreases along the experimental years down to the under-mesobasic class (81-90%).

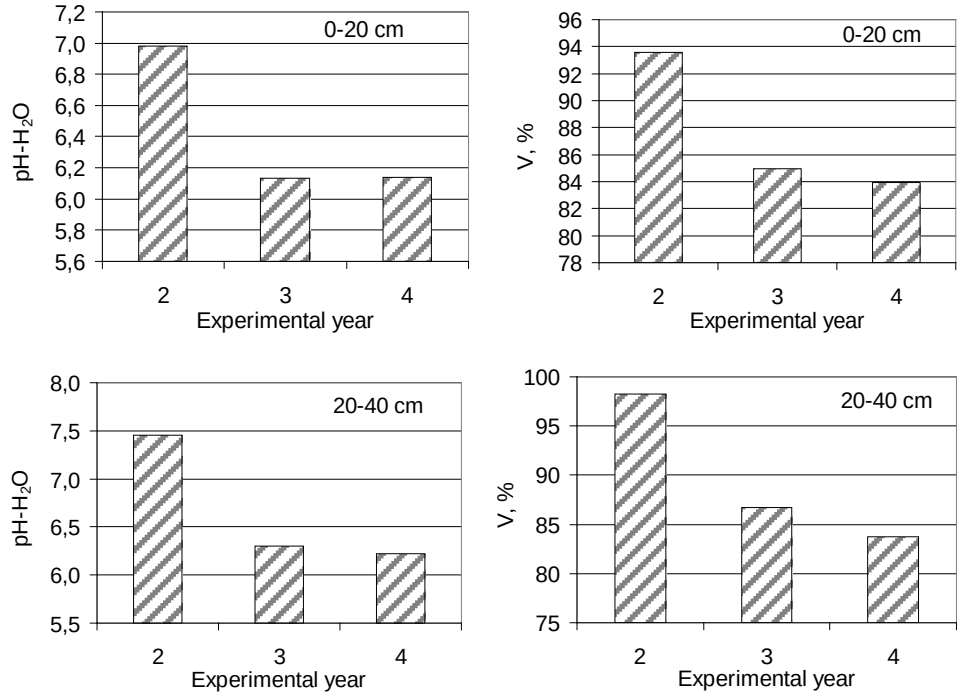

Fig.1 – Changes in soil reaction (pH_{H_2O}) and base saturation degree (V) along three experimental years

Very few and rather small differences occur during the three experimental years in the soil macro elements contents (Table 1).

The nitrate nitrogen ($N\text{-}NO_3$) contents are rather low, approximately two times lower than the non-fertilized soils normal content (up to 20 mg/kg, Lăcătuşu, 2006) and 2-4 times lower than the fertilized soils one (20-40 mg/kg, Lăcătuşu, 2006). It may be a problem for plant nutrition, but one of the ecological agriculture's goals is the absence of nitrates, especially from the crops. The nitrates contents don't vary along the experimental years. This was expected, as care is taken that the manure used for fertilizing ecological crops be free of these compounds.

The total nitrogen contents belong to the average interval (0.141-0.270%, Florea et al., 1987) in the upper layer (0-20 cm) and to the low one (0.100-0.140%) in the next layer (20-40 cm). Its diminution along the experimental years is not statistically significant but has to be monitored recurrently. The fact can be taken

into account too that ecological agriculture doesn't aim to improving the soil fertility properties but to their preservation.

The humus content assessed for a medium texture is medium in the first layer and low in the next one, suitable for plant growth but with a slight decreasing tendency which is not statistically ensured though.

Tab.1 – Macro elements contents of the experimental soils along the three experimental years

Experimental Year	$N\text{-}NO_3$ mg/kg	Nt %	Humus %	C/N	P_{AL} mg/kg	K_{AL} mg/kg
0-20 cm						
II	9.3	0.187	3.08	11.1	6	202
III	8.5	0.177	2.76	10.5	5	201
IV	10.4	0.174	2.70	10.5	18*	256**
DL 5%	*3.11*	*0.033*	*0.576*	*0.603*	*10.1*	*35.6*
DL 1%	*4.72*	*0.050*	*0.872*	*0.914*	*15.3*	*53.9*
DL 0.1%	*7.58*	*0.080*	*1.402*	*1.469*	*24.7*	*86.6*
20-40 cm						
II	8.9	0.142	1.93	9.2	1	184
III	5.7	0.145	2.25	10.5*	2	178
IV	5.4	0.125	1.84	10.0	11**	202**
DL 5%	*7.38*	*0.029*	*0.485*	*0.55*	*5.4*	*9.6*
DL 1%	*6.64*	*0.044*	*0.735*	*0.83*	*8.1*	*14.5*
DL 0.1%	*10.67*	*0.071*	*1.182*	*1.34*	*13.1*	*23.3*

The C/N ratio describes a good quality organic matter with mineralization rate that ensures an adequate nutritional elements supply for plants' growth (according to Davidescu and Davidescu, 1992, a 9-11 C/N ratio corresponds to a high soil fertility for field crops).

The mobile phosphorus and potassium contents increases are to be noticed, in the last year, due to manure fertilization. From very low in the first horizon and extremely low in the next the mobile phosphorus supply becomes medium, respectively low after the third experimental year. The increases are statistically ensured, significant in the first layer and distinctly significant in the next. It is to be presumed that mobile phosphorus supply would increase during several years of

plants' ecological growth which is very important for Romanian soils as they generally have low supplies of this nutritional element. The potassium supply remains high in the first horizon and medium in the second but it increases significantly after the third experimental year, even into the high content domain in the 20-40 cm horizon.

The mobile micro elements contents (Tab.2) belong to the low and medium values intervals, suitable for plant growth and far from toxicity conditions. The very significant increases of iron in both horizons and of manganese in the 20-40 cm one is to be noticed with no consequence on soil fertility and plant nutrition conditions.

Tab. 2 – Micro elements contents of the experimental soils along the experimental years

Experimental Year	Zn	Cu	Fe	Mn
	mg/kg			
0-20 cm				
I	1	4	40.6	17.9
II	1.3	3.7	62.8***	42.7
III	1.5*	4.5	63.5***	35.5
DL 5%	0.50	0.84	8.12	8
DL 1%	0.76	1.27	12	12.28
DL 0,1%	1.21	2.05	19.77	19.74
20-40 cm				
I	0.7	3.8	27.1	14.9
II	0.8	3.9	56.0***	28.1***
III	0.9	5.3	74.9***	20.7*
DL 5%	0.41	1.54	10.54	4.36
DL 1%	0.61	2.32	15.97	6.60
DL 0,1%	0.99	3.74	25.67	10.60

Conclusions

Soil reaction and the base saturation degree decrease along the experimental years, which is a matter of concern.

The slight increase of the phosphorus content in the third experimental year is very important as it shows that the manure fertilization is efficient. It is also important regarding that Romania's soils are poor in mobile phosphorus and phosphorus fertilizers are expensive.

The potassium increase supports the efficiency of the manure fertilization.

Except for the reaction and base saturation degree decrease, the ecological *Salvia officinalis* growth ensures the conservation of the soil's fertility properties and even improves the mobile phosphorus and potassium contents.

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