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INFLUENCE OF ORGANIC AND MINERAL FERTILIZATION ON THE LEVEL OF SOIL FERTILITY IN A LONG DURATION EXPERIMENT IN MOARA DOMNEASCA - ILFOV

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Abstract

In this paper the influence of different organic or mineral fertilizers on soil fertility level is studied in a long term experiment, in field, on reddish preluvosol. Soil vital activity (respiration and cellulozolitic one) and pedoenzymic activities (catalase, saccharase, phosphatase and amidase) were analyzed. For a good and easier interpretation of experimental data, the partial and synthetic indicators of soil fertility level are presented. The final conclusion, which can be presented, is that the fertilization with composted manure (30 t/ha/3 year), refuses of sugar-beet and a minimum dose of mineral fertilizers are the best for soil fertility.

INTRODUCTION

In the second part of the 20th century, and at present also, the applied agrotechnologies have determined parallelly with the high crops, the soil fertility degradation. However, all these observations were made by the means of the soil chemistry, phytopatology and entomology of plants as a consequence of chemical treatments used in agriculture. European Commission "EC agricultural policy for the 21-st century, Bruxelles, 1994" presented one's own proposals for a sustainable agriculture, but the determinant measures were of economic nature, not regarding to the soil fertility. Because we are interested to know the impacts of the chemical fertilizers and the organic fertilization on soil fertility, we analyzed the soil fertility evolution in a field experiment on reddish preluvosol, using biotical and pedoenzymic tests.

MATERIAL AND METHODS

1.1. In experimental field. Location: Experimenal and Training Station from Moara Domnească, Ilfov County on reddish preluvosol. The experiment has been carried out since 1992, with 3 plants in crop-rotation (sugar beet, winter wheat and winter barley), with **factor A (organic fertilization): a_1**-Organically and mineral unfertilized; **a_2**-Manure (natural composted, with cca. N_t 1%) in **the** second year

from the application of 30 t/ha, at 3 years; **a_3**-Application of 40 t/ha (leaves and crowns of sugar-beet), and **factor B (annual mineral fertilization): b_1.** N_0;**b_2.** N_{50}; **b_3.** N_{100}; **b_4.** N_{150}; **b_5**. N_{200} kg/ha. The soil samples were sampled in autumn, after the fertilization with ammonium nitrate and with supperphosphate (a part of the total dose). This experiment was founded in collaboration with J.V. Liebig University from Giessen, Germany [4].

1.2. ***Pedobiological research*.** Sampling was made from each randomized repetition of the variants. Analitycal data express the soil biotical potentials of: respiration and cellulolyse and potentials of: catalase, saccharase, phosphatase and amidase. The work methods are described after [10, 11, 12] and Dincă and Ştefanic [in this papers].

Soil respiration was quantified in Ştefanic's respirometer. Soil cellulolyse was quantified by the method of [12], after 18 days of incubation, at 28^0C. Soil catalase activity was quantified by the automatic catalase apparatus [10]. Soil saccharase activity was quantified by Hofmann and Seegerer's method, improved by us [4]. Soil total phosphatase activity was quantified by an original method of us [6, 1]. Soil total amidase activity was quantified by the original method of us [11], in the same conception as for phosphatases.

Dincă and Ştefanic have achieved an improved of the laboratory technique by determining the total phosphatase and total amidase activities in the same enzymic mixture and filtrate.

1.3. Calculation of partial and synthetic indicators for estimating the soil ferility level. According with his definition of soil fertility [7], a maximal empirical value (MEV) have proposed and used the calculation of some indicators of soil fertility level. A maximal empirical value (MEV) for each analytical result was introduced as reference. For classifying the level of each result and for making it comparable with other results it uses this formula: X% = Xa*100 / MEV in which: X % = percentual value of each parameter; Xa = analytical result. MEV for respiration = 150; for cellulolyse this is even in %; for catalase is 2000, for sacharase is 3500; for total phosphatase = 25 and for total amidase = 1.

Formula for soil biotical indicator is: **IVAP%** = Respiration % + Cellulolyse % / 2.

Formula for soil enzymical indicator is: **IEAP%** = (Catalase % + Saccharase % + Total Phosphatases % + Total Amidases %) / 4.

Finally, **B**iological **S**ynthetic **I**ndicator is calculated**: BSI%=IVAP%+IEAP% / 2**

RESULTS AND DISCUSSION

Influence of agricultural measures applied, annually, on reddish – preluvosoil from Moara Domnească - Ilfov, has produced some modifications in the level of soil fertility, presented in the tables 1 and 2. The influence of fertilizers on soil vital activity can be generally appreciated by the Indicator of Vital Activity Potential

(IVAP %). The IVAP % registered better influences on soil vitality by mineral fertilization (table 1), especially in variants fertilized with plant remains or manure. A second group of laboratory tests for evaluating human influence on soil fertility is that of pedoenzymes. We introduced (after Ştefanic, 1994) the following tests: catalase, saccharase, total phosphatases and total amidases, all this enzymes exist free in soil, from micro- and macropopulation or from other terrestrial sources, being named *pedoenzymes.*

Table 1

Influence of organic and mineral fertilization of reddish preluvosol on respiration (CO_2 evolved – mg/100 g soil d.s.) and biodegradated cellulose (%), estimated by the Indicator of Vital Activity Potential (IVAP %)

Experimental variants		Respiration	Biodegradated cellulose	IVAP %
a_1 Unfertilized organically	b_1-N_0	**e** 40.15	**b** 13.38	**b** 20.08
	b_2-N_{50}	**e** 40.25	**b** 17.38	**b** 23.44
	b_3-N_{100}	**d** 52.26	**a** 25.20	**a** 30.02
	b_4-N_{150}	**c** 58.21	**a** 30.20	**a** 34.5
	b_5-N_{200}	**c** 63.72	**b** 8.690	**b** 25.58
a_2 Manure (natural composted) in the second year from the application of 30 t/ha	b_1-N_0	**e** 44.09	**b** 17.38	**b** 23.39
	b_2-N_{50}	**d** 57.71	**b** 20.69	**a 29.58**
	b_3-N_{100}	**d** 56.57	**a** 26.80	**a 32.25**
	b_4-N_{150}	**d** 51.02	**a** 35.11	**a** 29.94
	b_5-N_{200}	**c** 64.53	**b** 15.43	**a** 29.23
a_3 Application of 40 t/ha (leaves and crowns)	b_1-N_0	**e** 39.51	**b** 8.170	**c** 17.25
	b_2-N_{50}	**d** 57.47	**b** 17.81	a 28.06
	b_3-N_{100}	**a** 87.41	**b** 9.47	**a 33.87**
	b_4-N_{150}	**a** 90.67	**c** 6.360	**a 33.40**
	b_5-N_{200}	**b** 77.22	**b** 16.42	**a** 33.95
DLP 5%		6.75	13.95	7.67

Researches [2] put in evidence that the process of fermentative burning of energetic material from the colloidal particle surface of soil is controlled by catalase. According to one sees from table 2, mineral fertilizers, applied to soil since 1992, have had a negative influence on catalase activity in soil. The highest activity was found only in lack of mineral fertilization. The chemical reaction of soil, treated with ammonium nitrogen and superphosphate, diminished between pH 5.27 and 4.92, depending on the N dose. Catalase is destroyed at pH 3 [5]. Concerning the saccharase activity, the variations are't dependent of the treatments. The following two hydrolytic enzymes, phosphatase and amidase (in an original methodological conception [6, 1, 11] have given possibility to find oneself whether the organic and mineral manures have somebody influence in accumulation of enzymes and in the same time, in the concentration of specific substrates. The classical enzymic

methods have given information only about the accumulation of phosphomonoesterase, diphosphomonoesterase, nuclease etc, or urease, asparaginase etc. introducing the specific enzymical substrate. In our case, one ascertains that, organic or mineral manures applied in soil, along of time, hadn't certain effect in the hydrolysis of phosphorics or amidics compounds. Indicator of Enzymic Activity Potential (IEAP %) shows that only in the case of application of vegetal refuses ($\mathbf{a_3}$) and high doses of mineral N one manifests a dwpression of enzymic potential.

Table 2

Influence of organic and mineral fertilization of reddish preluvosol on pedoenzymic activity estimated by the Indicator of Enzymic Activity Potential (IEAP %)-Data are repported to 100 g soil d.s.

Experimental variants		Catalase (O_2 cm^3)	Saccharase (glucose mg)	Phosphatase (P mg)	Amidase (NH_4 mg)	IEAP %
$\mathbf{a_1}$ Unfertilized organically	b_1-N_0	a 240.38	b 556.66	a 6.57	b 0.11	a 15.31
	b_2-N_{50}	a 306.40	b 609.79	b 4.99	a 0.14	a 16.57
	b_3-N_{100}	b 186.45	b 537.33	a 6.10	a 0.13	a 12.97
	b_4-N_{150}	b 187.16	a 690.70	b 4.50	0	a 11.78
	b_5-N_{200}	b 187.65	a 703.50	b 4.56	a 0.02	a 11.68
$\mathbf{a_2}$ Manure (natural composted) in the second year from the application of 30 t/ha	b_1-N_0	a 240.18	a 657.87	b 4.82	a 0.09	a 14.85
	b_2-N_{50}	b 218.15	b 608.21	b 5.20	a 0.03	a 12.07
	b_3-N_{100}	b 210.72	b 612.60	a 7.58	a 0.17	a 14.12
	b_4-N_{150}	b 182.40	c 463.12	c 0.71	a 0.15	b 9.47
	b_5-N_{200}	b 166.74	c 500.16	0	b 0.05	b 6.98
$\mathbf{a_3}$ Application of 40 t/ha (leaves and crowns)	b_1-N_0	a 277.71	a 739.62	c 1.64	a 0.03	b 11.25
	b_2-N_{50}	b 151.78	b 602.40	0	0	c 5.90
	b_3-N_{100}	b 166.53	c 462.67	b 4.23	b 0.04	b 10.10
	b_4-N_{150}	b 203.36	b 509.95	c 1.42	a 0.16	a 11.49
	b_5-N_{200}	b 225.20	b 568.10	0	a 0.15	b 10.60
LSD P = 5%		78.52	109	1.96	0.15	5.11

In tables 3 and 4 are presented the data concerning the organic and mineral manures which influenced the soil vital and biochemical processes, using Biological Synthetic Indicator (BSI%), as a unique criterion for knowing which agrotechnology can be recommended for maintaining a good soil fertility. The type of organic fertilization (Factor A) didn't influence, significantly, the evolution of soil fertility. But we must specify that theapplicated manure had only cca. Nt 1%. The influence of the factor B is significant even at N_{50} dose. With refference to the N doses, one observs that in the lack o organic manuring or after an year after the application of manure, the dose N_{200} had an negative influence on soil fertility. The

same dose had a positive effect in the case of the incorporation of the sugar-beet refuses, as organic manure.

In the table 4, we are presenting a comparison between all experimental variants for having a complex information about the soil fertility level and a suitable technology for a sustainable agriculture with minimum expenses. In the preface of the admirable book [3] about the method for conserving or restablishing the soil fertility, Louis wrote: "What is biologic correct is economic advantageous". Examining the table 4, one observes that with the letter- **a** - many data characterize a favorable influence of the different agrotechnologies on the soil, but we must recommend only the variant $\mathbf{a_2b_2}$ for applying, because the best fertilization is that with composted manure (30 t/ha at 3 years).

Table 3

Influence of organic and mineral fertilization of reddish preluvosol from Moara Domnească, Ilfov County, Experimental Station, on soil fertility level, estimated by Biological Synthetic Indicator (BSI %). Factorial and interfactorial influences

F_A / F_B	b_1-N_0	b_2-N_{60}	b_3-N_{100}	b_4-N_{150}	b_5-N_{200}	F_A
a_1-Unfertilized organically	a 17.70 b	a 20.00 a	a 21.49 a	a 23.14 a	a 18.63 b	20.19
a_2-Manure (natural composted)	a 19.12 a	a 20.82 a	a 23.18 a	a 19.70 a	b 18.10b	20.18
a_3-Application of 40 t/ha (leaves and crowns)	b 14.25 b	b 15.07 b	a 21.98 a	a 22.44 a	a 22.27 a	19.20
Factor B	17.02 b	18.63 a	22.22 a	21.76 a	19.67 a	

Limite differences DL P $5F_A$% : F_A unsignificant; F_B 2.39; B x A 4.3; A x B 4.9

Tabel 4

Effect of fertilization mode on reddish preluvosol fertility in connection with the technological expenses

$\mathbf{a_1}$ Unfertilized organically	$b_1 - N_0$	b 17.70
	$b_2 - N_{50}$	**a 20.00**
	$b_3 - N_{100}$	**a 21.49**
	$b_4 - N_{150}$	**a 23.14**
	$b_5 - N_{200}$	b 18.63
$\mathbf{a_2}$ Manure (natural composted) in the second year from the application of 30 t/ha	$b_1 - N_0$	**a 19.12**
	$b_2 - N_{50}$	**a 20.82**
	$b_3 - N_{100}$	**a 23.18**
	$b_4 - N_{150}$	**a 19.70**
	$b_5 - N_{200}$	b 18.10
$\mathbf{a_3}$ Application of 40 t/ha (leaves and crowns)	$b_1 - N_0$	b 14.25
	$b_2 - N_{50}$	b 15.07
	$b_3 - N_{100}$	**a 21.98**
	$b_4 - N_{150}$	**a 22.44**
	$b_5 - N_{200}$	**a 22.27**
LSD P = 5%		4.39

CONCLUSIONS

1. Soil organic fertilization, valuated by Biological Synthetic Indicator (BSI %), didn't significantly influenced the level of the fertility. But the manure had only cca. N_t 1%, that is 10 kg/ha/year.
2. Mineral fertilization, by a part of the total dose, has influenced favorably, significantly, the soil vitality. N_{200} kg/ha influenced negatively the soil fertility.
3. The favorable actions on soil fertility level were estimated by the Biological Synthetic Indicator (BSI %), in all factorial interactions, except with N_{200}.
4. Application of the mineral fertilizers has diminished the chemical reaction of the soil and by this, the soil biotical activity.

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