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EFFECT OF ORGANIC AND MINERAL MANURING ON MICROBIAL PROCESSES OF REDDISH PRELUVOSOL IN ROMANIAN FIELD AFTER 19 YEARS OF EXPERIMENTATION

DUMITRU ILIE SĂNDOIU[1], LIVIU DINCĂ[1], GHEORGHE ŞTEFANIC[1], COSTICĂ CIONTU[1] and AURELIAN PENESCU[1]

[1]University of Agronomic Sciences and Veterinary Medecine, Departament Soil Sciences, Blvd Marasti nr. 59, sect. 1, 011460 Bucharest, Romania
Corresponding author: Dumitru Ilie SĂNDOIU, E-mail: dinca_liviu84@yahoo.com

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This research approaches the vital features and chemical reaction modifications of reddish preluvosol, in a medium-term experiment set up in 1992, from Experimental Didactic Station, in Moara Domnească, Ilfov county. The experiment was bifactorial of type 3 *x* 5 in 3 repetitions, with factor A (organic manuring: a_1- remanence manure 30 t/ha; a_2- remanence manure 30 t/ha; a_3- applying of 40 t/ha sugar beet) and factor B (mineral manuring: b_1- N_0; b_2- N_{60}; b_3- N_{100}; b_4- N_{150} and b_5- N_{200} and 70 kg P_2O_5 annually). For laboratory analyses, the soil samples were sampled in spring 2011, from each variant. The following soil analyses were made for characterizing the principal vital processes: respiration and biodegradation of cellulose. Also, the chemical reaction of soil was tested. For a general appreciation of anthropic influence in soil vitality, the Indicator of Vital Activity Potential (IVAP%) was calculated. Test results showed that the highest levels of soil respiration and of cellulose biodegradation were found in organic unmanured variant + N_{200} (from ammonium nitrate) but in this variant pH decreased, as in variant with 40 t/ha/3 years of leaves and crowns of sugar-beet. The highest pH achieved in variant with dung compost, without mineral manure. Experimental data show that soil must be liming for the growth of pH and improving of its vitality.

Key words: manure, chemical reaction, soil respiration, soil cellulolytic activity.

INTRODUCTION

Management strategies include varying levels of fertilization, and are meant to increase plant productivity, with less regard for dynamics below ground [2,3].

Organic matter role in vital processes for maintenance and development of soil must not still demonstrate. What must understand is the fact that in agricultural production process, to stimulate the mineralization in soil, without permanent construction of a new humus generation, transform the agriculture in “agricultural mining”, with grave consequences on fertility state of agricultural soils [4,9,15,16,17].

Soil pH is widely accepted as a dominant factor that regulates soil nutrient bioavailability, vegetation community structure, plant primary productivity and a range of soil processes including soil microbial community structure and activity [5,6].

In the present communication we are proposing to interpret the effect of different organic and mineral manures on the soil vital processes and of pH modification, which characterize the reddish preluvosol from Experimental Didactic Station from Moara Domneasca-Ilfov.

MATERIALS AND METHODS

In spring of 2011, it was sampled the soil from a field experiment of Experimental Didactic Station from Moara Domneasca-Ilfov. The experiment is bifactorial of type randomized 3 *x* 5, in 3 repetitions, with factor A: a_1- remanence manure 30 t/ha; a_2- applying of 40 t/ha sugar beet; a_3-manured with leaves and crowns of sugar-beet and factor B: b1-N_0; b2-N_{60}; b_3-N_{100}; b_4-N_{150}; b_5-N_{200} from ammonium nitrate and P_{70} from superphosphate. The experiment was founded in 1992 at Didactic Experimental Station from Moara Domneasca, Ilfov county, on reddish preluvosol, having a clay loam texture and 2.17-2.64% humus (1.26-1.53 C_t%). The air temperature varied between 10.6^0 C and 12.6 in 2010 and precipitations, between 305 mm (2010), 444.9 mm (2002) and 823.0 mm (2005). For laboratory analyses, the soil samples were sampled in spring 2011, from each variant from the depth 0-20 cm, after harvesting the winter wheat. The crop rotation was: sugar beet, winter wheat and barley. The influence of the manuring mode on soil chemical reaction was electrometric determined[8]. The fresh soil samples were sieved by a sieve of 2 mm, all visible plant remains were removed and then were tested for respiration[10] and cellulose biodegradation potentials[11,18]. Then was calculated[11–13] the Indicator of Vital Activity Potential (IVAP%) of the soil. The results were statistically interpreted by multiple test[7,14] and by correlations. For an easier interpretation of the experimental data, the bifactorial tables were utilized. By the significant limit differences (LD), the experimental results were introduced and interpreted (as monofactorial) by multiple test for factors A, B and their interactions (A × B and B × A), the data being grouped and significantly separated by letters; letter “a” for the higher value and for those inferior, the letters: “b”, “c” etc.

RESULTS AND DISCUSSION

Influence of organic and mineral manuring on soil chemical reaction

In the table 1, one observes that at average of factor A, the variant with stable dung compost had a value significantly higher (5.07) than that of variants unmanuring or with sugar-beet remains. At the average of manuring (factor B) with increasing doses of mineral nitrogen, one observes the more negative influence of factor B on chemical reaction of soil. Variant unmanured with mineral nitrogen is framed in the group “a” with the highest value of pH (5.22) and then diminishes by the increase of N-doses, from pH 5.22 to 4.74 d and 4.69 d.

The acidulation effect of soil by chemical manures with nitrogen and phosphorus is significant[1] explained this by the effect of anions contained or which resulted from nitrates, that are not absorbed in soil. This effect is evidenced in the Table 1.

In the soil organic unmanured, the nitrogen doses have provoked the diminution of pH after N_{60}. When the soil received dung compost, this phenomenon was produced even in variant with N_{60}. The negative effect of nitrogen doses is very visible in the applying cases of increasing doses of nitrogen in soil manured with sugar-beet remains which intensified the mineralization process.

The applying of dung compost, without doses of mineral nitrogen, determined the highest level of soil pH.

Influence of organic and mineral manuring on respiration potential activity of reddish preluvosol

In the case of mineral unmanured, one observes (Table 2) that maximal value of respiration was obtained to sugar-beet remains and unorganic manuring (39.85 and 43.61). Generally, one can say that the factor A had a very little influence on soil respiration potential. But, this, in combination with mineral nitrogen manure, determined an increased soil respiration potential, because the sugar-beet furnished the necessary energy for a higher activity. These results confirm those obtained by Ştefani [16,17].

In Figure 1, the negative correlation between soil pH and soil respiration potential is significant, in conditions of manuring with increasing N-doses in unorganic manuring variants and of the manuring with composted dung.

Influence of organic and mineral manuring on cellulolytic potential of reddish preluvosol

Cellulolytic activity in reddish preluvosol was different influenced to the increasing N-doses (Table 3). Influence of organic manuring (factor A) was not significant in soil cellulolytic activity, but mineral manuring (factor B) was significant, being stimulant by N-dose increase (at N_0 and N_{60} = 3.80 c and 3.86 c; at N_{100} and N_{150} = 4.20 b and 4.62 b and at N_{200} = 5.07 a).

Table 1

Influence of organic and mineral manuring on chemical reaction (pH-H_2O) of reddish preluvosol

A \ B	b_1– N_0	b_2–N_{60}	b_3-N_{100}	b_4–N_{150}	b_5–N_{200}	**Average A**
a_1– unfertilized	b 5.01 a	b 4.98 a	b 4.76 b	a 4.69 b	a 4.64 b	b 4.82
a_2– remanence manure 30 t/ha	a 5.47 a	a 5.27 b	a 5.01 c	a 4.83 d	a 4.78 d	a 5.07
a_3– applying of 40 t/ha sugar beet	b 5.16 a	b 4.99 b	b 4.84 b	a 4.70 c	a 4.66 c	b 4.87
Average B	5.22 a	5.08 b	4.87 c	4.74 d	4.69 d	
Factors	*A*	*B*	*B* A*	*A *B*		
DL P 5%	*0.12*	*0.08*	*0.16*	*0.15*		

Figures in the same column, preceded by different letters are significantly different at P≤0.05
Figures in the same row, followed by different letters are significantly different at P≤0.05

Table 2

Influence of organic and mineral manuring on respiration potential of soil (CO_2 mg/100 g soil d.s.)

A \ B	***b_1 – N_0***	***b_2 – N_{60}***	***b_3 – N_{100}***	***b_4 – N_{150}***	***b_5 – N_{200}***	*Average A*
a_1 – unfertilized	a 39.85c	a 43.17c	a 58.43b	a 59.03b	a 70.34a	a 54.168
a_2 – manure 30 t/ha	***b 36.58d***	***b 41.27c***	***a 58.15a***	***b 49.71b***	***b 47.83b***	***b 46.710***
a_3 – applying of 40 t/ha sugar beet	***a 43.61a***	***a 45.96a***	***b 44.31a***	***c 40.80b***	***c 43.62a***	***b 43.663***
Average B	***40.01 d***	***43.46 c***	***53.63 a***	***49.84 b***	***53.93 a***	
Factors	***A***	***B***	***B*A***	***A*B***		
DL P 5%	***3.421***	***2.962***	***5.329***	***5.131***		

Figures in the same column, preceded by different letters are significantly different at P≤0.05
Figures in the same row, followed by different letters are significantly different at P≤0.05

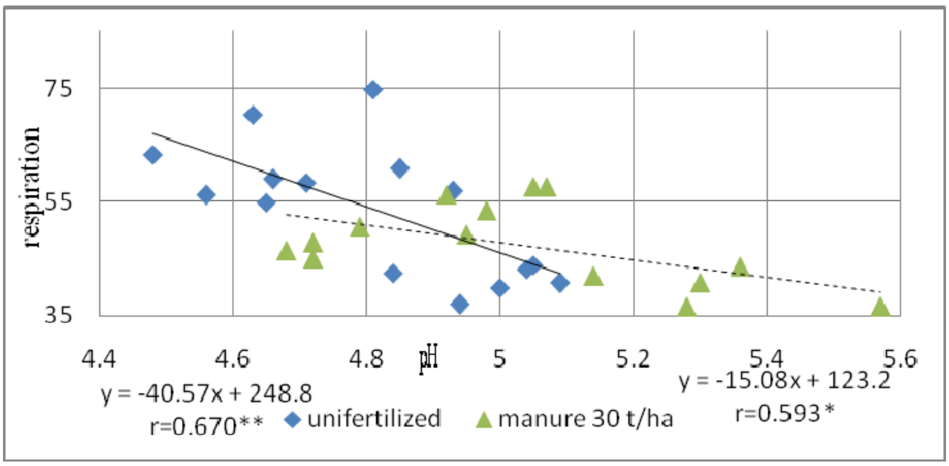

Fig. 1. Regression of respiration potential as against pH values, in unorganic manure variant to manure, 30 t/ha.

Table 3

Influence of organic and mineral manuring on soil cellulolytic activity (biodegraded cellulose %)

A	$b_1 - N_0$	$b_2 - N_{60}$	$b_3 - N_{100}$	$b_4 - N_{150}$	$b_5 - N_{200}$	Average A
a₁– unfertilized	*a 4.52 b*	*a 3.84 b*	*a 4.34 b*	*a 4.72 b*	*a 5.81 a*	*a 4.64*
a₂–remanence manure 30 t/ha/years	*a 3.85 b*	*a 3.98 b*	*b 3.65 b*	*a 4.60 a*	*a 5.14 a*	*a 4.24*
a₃– applying of 40 t/ha sugar beet	*b 3.02 b*	*a 3.76 b*	*a 4.68 a*	*a 4.56 a*	*b 4.26 a*	*a 4.05*
Average B	*3.80 c*	*3.86 c*	*4.22 b*	*4.62 b*	*5.07 a*	
Factors	***A***	***B***	***B*A***	***A* B***		
LD P 5%	*0.730*	*0.440*	*0.888*	*0.763*		

Figures in the same column, preceded by different letters are significantly different at P≤0.05
Figures in the same row, followed by different letters are significantly different at P≤0.05

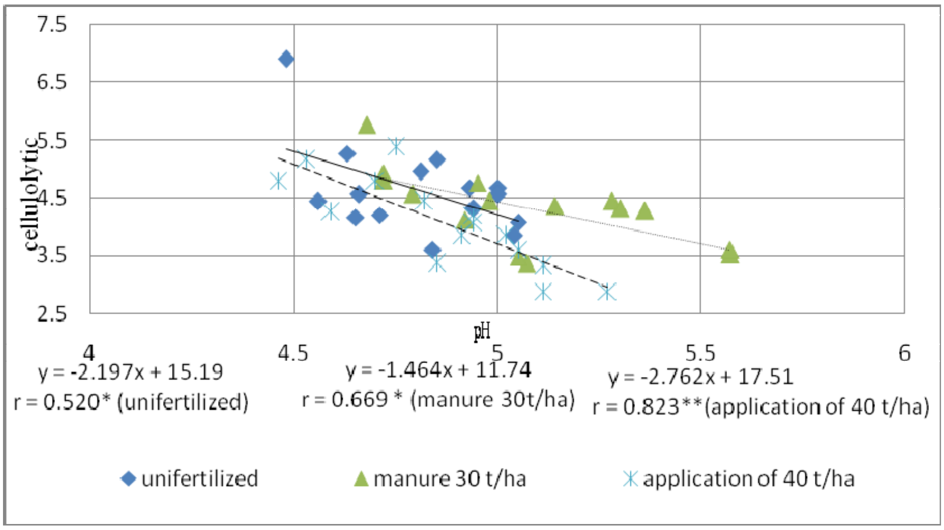

Fig. 2. Regression of cellulolytic activity as against with pH in unorganic manure variant to manure 30 t/ha, or applying of 40 t/ha sugar beet remains.

Table 4

Influence of organic and mineral manuring on Indicator of Vital Activity Potential (IVAP%) of soil

B / A	$b_1 - N_0$	$B_2 - N_{60}$	$b_3 - N_{100}$	$b_4 - N_{150}$	$b_5 - N_{200}$	Average A
a₁– unfertilized	*a15.54d*	*a16.31d*	*a21.65c*	*a22.04b*	*a26.35a*	*a 20.38*
a₂– remanence manure 30 t/ha	*b14.11c*	*a15.75c*	*a21.21a*	*b18.87b*	*b18.51b*	*b 17.69*
a₃– application of 40 t/ha	*a16.05a*	*a17.20a*	*b17.11a*	*c15.88a*	*c16.67a*	*b 16.58*
Average B	*15.23c*	*16.42c*	*19.99 a*	*18.93 b*	*20.513a*	
Factors	***DL A***	***DL B***	***B*A***	***A* B***		
DLP 5%	*1.45*	*1.03*	*1.96*	*1.78*		

Figures in the same column, preceded by different letters are significantly different at P≤0.05
Figures in the same row, followed by different letters are significantly different at P≤0.05

It is possible as an increase of soil acidity to determine an increase of fungy participation, with increased efficiency in cellulolytic processes.

Pursuing the influence of mineral manuring, in unorganic manuring variant, one observes that the N_{200} was in group “a” of values, 5.81%.

Under dung compost influence, to the application of N_{150} and $N_{200,}$ they were obtained the highest values: 4.60%, respective 5.14%; N_{100} till N_{200} and sugar-beet remains produced 4.68% till 4.26% biodegraded cellulose.

Synthetic indicator (IVAP%) from Table 4 shows that in organic unfertilized variants it was produced the highest vital activity in the case of the applying of maximal dose of N_{200}, which strong has acidulated the soil (show Table 1), even in organic manuring variants. One can take in consideration that acid medium favoured the fungy (by comparison with bacteria) and these determine a stronger cellulolytic activity.

In variants with remains of sugar beet, the applying of different doses of ammonium nitrate hasn’t produced modifications of vital activity level, what points out that the surplus of organic and energetic material sustained the high level of soil vitality.

CONCLUSIONS AND FUTURE PROSPECTS

1. Applying of mineral manures, only over N_{60} , determined the diminishing of pH (H_2O).
2. When composted dung was applied, without ammonium nitrate, it was realized an increase of pH (5.47) as against of unfertilized variant (5.01).
3. Manuring with lives and crowns of sugar-beet hasn’t modified significantly pH of soil.
4. Remanence manure 30 t/ha provoked a reduction of respiration potential, probably owing to a higher stability of organic combinations against of respiration process.
5. Soil respiration potential was stimulate by chemical manures to high doses.
6. Soil respiration potential and cellulolytic potential were negative correlated with soil pH.

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