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INFLUENCE OF NITROGEN AND PHOSPHORUS FERTILIZATION ON SOIL ORGANIC MATTER CONTENT

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Abstract

Influence of nitrogen (N) fertilization (in doses of 40, 80, 120, 160 kg/ha) and phosphorus (P) fertilization (in doses of 40, 80, 120, 160 kg/ha) on soil organic matter content was studied in a long term experiment at Drăgăneşti Vlaşca. The studied soil was classified as a Cambic Phaeozem and the samples were collected from the surface layer (0-20 cm) after the wheat was harvested. The obtained results showed the following: none of applied nitrogen doses not significantly influenced the content of humus in the soil; when applying 40 kg/ha of phosphorus there was no influence on the content of humus in the soil, instead applying 120 and 160 kg/ha resulted in distinct significant increases of the humus content; simultaneous application of 80-160 kg/ha P and 40-160 kg/ha N led to distinct and very significant increases of the soil humus content; high doses of nitrogen (120 and 160 kg/ha) significantly increased the level of soil hydrolytic acidity. Applying high doses of N resulted in a drop of soil pH. Thus, the pH values decreased with 0.29 to 0.37 units, reaching the point where liming was necessary. In wheat culture, results obtained in 39 years of experiments showed that nitrogen and phosphorus fertilization has led to significant yields increases as compared with the unfertilized control. The highest yields were obtained when applying the maximum tested doses of fertilizers.

Key words: *soil, organic matter, fertilization, long term experiences.*

INTRODUCTION

Research conducted within the National System of Soil Quality Monitoring showed that the level of humus in the soil horizon surface is extremely small on 0.74% of the surface, very little on 4.14%, lower on 42.57%, middle to 31.00%, 10.30% great, very big on 3.29%, extremely high on 6.26% and excessive on 1.70% (Dumitru et al., 2000).
Unfortunately the increasing trend of areas with low humus continued to grow under the influence of agricultural technologies. Thus areas with small reserves, very low and extremely low up 35% from 4.876 million to 7.485 million ha, 1990-2000 (Dumitru, 2003). That led system to evaluate the influence of mineral fertilization on sequestration of organic carbon in soil. This could be done only under certain experiences long as it was found that any type of fertilizer we apply not found statistically significant changes in the supply of organic matter, N, P, K, macronutrients and micronutrients due to resilience soil, applied doses, consumption by the plant. In these circumstances Mr. Academician Hera organized experimental fields with similar treatments in a series of 16 agricultural research stations to be able to discern long-term effects of different doses of mineral fertilizers on soil and agricultural production. The research conducted by Lazar et al. (2010) on experience for a long time on a Cambic Faeoziom showed that the only application of nitrogen fertilizers has led to the surface horizon a decrease of the soil reaction on the dose of N applied, as the N_{50} version, which became very significant decrease for N_{150} and N_{200} variants compared to unfertilized variant; phosphorus fertilizer no caused significant change of soil reaction; humus content and the total nitrogen were not significantly influenced by nitrogen and phosphorus differentiated treatments administered. The specialty literature provides information on influence ofmineral fertilization on the humus contenton the soil.

MATERIALS AND METHODS

The experiences were located at SCDA Teleorman and was established in 1976. In terms of physical-geographical Research

Station is located in Teleorman Plain, which is divided into several sub-units, and the area where it is located SCDA Teleorman Plain belongs Găvanu -Burdea.
Genetically Găvanu-Burdea is an absolute piedmont plain with altitudes ranging between 80-200 m. The entire surface is covered by a continues blanket of loess, thicknesses varying between 8-20 m below who meet marl, clay deposits of Villafranchianage, sand and gravel.
The general relief is relatively flat plain. Valleys that cross towards N-NW to S-SE succeed regularly, separating inter-parallel and somewhat symmetrical. Plain is crossed by numerous potholes especially in the south.
Meteorological data analysis during the growing of winter wheat in 2014-2015 leads to the following findings:at SCDA Teleorman, during September 2014 - June 2015 fell 608.8 mm rainfall with 178.23 mm more than the annual average of area -430.6 mm, indicating normal conditions for winter wheat, yet in some ponding sole occurred which led to a significant decrease in production.
The average air temperature did not exceed normal area, which resulted in the manifestation of a prolonged autumn, a mild winter.
To achieve experiences in the field subdivided parcels method was used with two factors and three replications. The first factor was the phosphorus (P) at doses of 0, 40, 80, 120, 160 kg/ha of superphosphate administered. The second factor was nitrogen (N) at doses of 0, 40, 80, 120, 160 kg N/ha, in the form of ammonium nitrate.
Experience has as rotating crops wheat and maize. Soil sampling was performed at the end of the growing season of the crop of wheat, the depth of 0-20 cm, according to the methods used in RISSA laboratories.
Ammonium nitrate applied experimental field contains 34.5% N of which half is nitrate nitrogen and half ammonia nitrogen. Because ammonium nitrate has a final acid reaction. Ages most appropriate application of nitrogen fertilizers are the requirements crop nitrogen are highest, thereby ensuring maximum efficiency of this nutrient but also other beneficial results such as the reduction of nitrogen quantities dissipated into the environment, that the risk of water pollution by nitrates in the soil infiltration or runoff. Crops sown in autumn due to the increased quantities of mineral nitrogen from organic matter mineralization existing in soil in autumn and more abundant precipitation season autumn-winter, there is an increased risk of contamination with nitric nitrogen through leaching and runoff. These reserves must take into account soil fertilizing of winter crops, the applied dose levels of nitrogen annual rate 1/4, established on the above mentioned principles.
Mineralization of organic matter and nitrates run phenomena are strongly influenced by how the land use and crop technologies (Code of Good Agricultural Practices, 2005).
Superphosphate applied is concentrated, containing 46% P_2O_5 total, 46% P_2O_5 soluble conventional soil and water. Phosphorus 44% P_2O_5 soluble fertilizers applied to soil has a low mobility, being mostly retained reversible forms adsorbed colloids ground.
The analysis methods were as follows:
- Humus - STAS 7184/21-82; wet oxidation volumetric method (Walkley-Black, the change Gogoașă);
- The pH determined potentiometrically in aqueous suspension, the ratio soil: water of 1: 2.5; using a combined glass electrode-calomel (pH units);
- SB - sum of basic cations, STAS 7184/12-88;by extraction with HCl 0.05 N, the method Kappen (me/100 g soil)
- Ah - hydrolytic acidity STAS 7184 / 12-88; at equilibrium in 1 N sodium acetate solution, the ratio soil: solution 1:2.5; by titration with NaOH in the presence of phenolphthalein, acidity extracted (me/100 g soil);
- T - total cation exchange capacity by calculation: T = SB + Ah (me/100 g soil);
- V_{Ah} - basic cation saturation level was determined by calculation (%).

Analytical data were statistically analyzed using analysis of variance.

RESULTS AND DISCUSSIONS

The influence of differentiated fertilization on soil reaction

The soil reaction influences most physical, chemical and biological soil properties (Puiu, 1980). On soils with high humidity occurs laundering depth basic exchangeable cations.

This process leads to depletion of bases in the surface horizon. The mobility of anions in soil increases with increasing soil acidity due to the number of negative charge that repels the complex absorption in the soil solution. The decrease in pH lowers the cation exchange capacity and reduce absorption intensity cations root. The root system of plants is poorly developed in depth, volume controls a small edaphic and supply plants with water and nutrients is reduced. Ammonia nitrogen fertilizers have a physiologically acid effect after nitrification, when an ammonium ion (N_4^+)generates two unbound H^+which acidify the soil reaction.

Humus mineralization has an acidifying effect, that effect is partly offset by ammonification amide nitrogen resulting from mineralization of humus, but the result of mineralization remain as distinct acidifying effect thereof (Rusu et al., 2005).

When applying fertilizers which give an acid reaction, acidifying effect on the soil is explained by depletion of bases. Higher consumption of bases with higher yields and leaching in the profile of the anion accompanying nutrients or fertilizers in the soil is formed by converting the nutrients cations (N_4^+) generates depletion of bases the soil. A net depletion of bases of the plowed soil layer causes only fertilizers that do not contain themselves bases (Ca, Mg, Na) and anions contained therein are not absorbed at all (HCO_3^-, Cl^-,NO_2^-), or absorb weak in soil (SO_4^{2-}). Acidification of the reaction by absorbing debazificarea argilohumic complex cation exchange can only occur in soils nesaurate bases. In soils saturated bases, changes of reaction are buffered by the presence of carbonates and the effect of decreasing the pH which it determines the presence of salts in soluble fertilizers so-called "salt effect" disappears with the removal of salts in the arable layer by consumption in the plant and leaching profile (Borlan et al., 1998).

Most crops grow and develop at a slightly acid pH - neutral, which is full of nutrients and mobility.

The correction is done with acid reaction amendments limestone containing basic cations that can change the H^+ ions and Al^{3+} (Budoi, 2000).

Figure 1 shows the influence of nitrogen on the pH after the analysis of the results of soil samples from the experimental field. After statistical processing of the data showed that applying nitrogen fertilizer ammonium nitrate, a decrease of soil reaction by nitrogen rate applied by 0.29 to 0.37 pH units from 5.75 weak acid, from 5.37 to moderately acidic unfertilized control. When applying doses of 40 and 80 kg N/ha were significant decreases distinct and significant, and the application doses of 120 and 160 kg N/ha decrease soil reaction was very significant area where the amendment is necessary.

The doses of phosphorus did not bring significant changes in soil reaction.

According to the literature wheat is a crop plant with medium acidity tolerance requirements of such crops include values of pH between 5.5 to 7.5 (Dodocioiu et al., 2009).

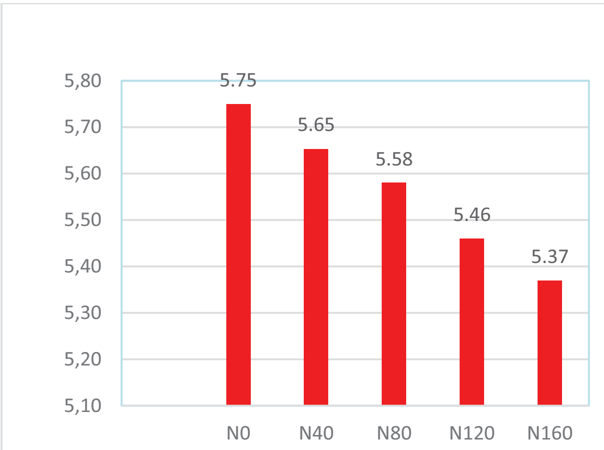

Figure 1. Influence of nitrogen dose on pH

Retention and cation exchange is a reversible process, regularly ensuring mobility cations for plant nutrition. Cation exchange is performed depends on the energy equivalent amounts and detention increases with atomic weight and valence cation, an exception to this rule cation H^+, which has the largest energy holding. Cation exchange depends on the degree of hydration inversely, the cation concentration in the soil solution (Dodocioiu et al., 2009).

Analytical data on the indicators used to determine the ability for cationic exchange: of the base parts (SB), the acidity of hydrolytic (Ah), the total capacity of the cation exchange (T) and the degree of saturation in the base cation (V_{Ah}) are shown in Table 2. The application of nitrogen fertilizers in doses of

120-160 kg N/ha resulted in an increase from unfertilized hydrolytic acidity from 1.64 with 1.57 me/100g soil, applying nitrogen fertilizer with phosphorus associated with causing a drop the base amount with 0.43, 0.75%, and the decline in base saturation of -4.23, 4.90%.
The total cation exchange capacity (T) recorded a significant increase in application doses and distinctly significant phosphorus $P_{120-160}$ (kg/ha). Nitrogen has determined about significant changes.
Figure 2 shows the influence of combined application of nitrogen and phosphorus on the properties of cationic exchange.

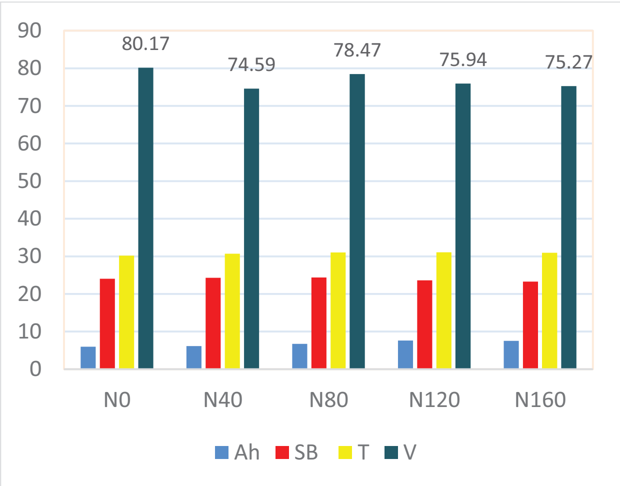

Figure 2. Influence of nitrogen dose on cationic exchange

Influence of nitrogen and phosphorus fertilization on the humus content

Soil organic waste decomposition is performed under the direct influence of microorganisms using this material as a source of food and energy. Once in the soil, crop residues are subject to microbial active which results in breakdown of carbohydrates and proteins, followed by decomposition slower cellulose, lignin, lipids and tannins, thus triggers the process of humification (Lăcătuşu, 2006).
Borlan et al. (1994) defined the terms "humus" and "humic substances" as inanimate organic component of soil resulting from the processing plant debris under the action of microorganisms and quantitatively assessed by organic carbon content by multiplying by 1.724 times. This coefficient is correlated with an average of 58% of carbon in humic substances. Blaga et al. (2005), defined as the essential component of humus soil, which gives it its peculiar property - reserve represents fertility and permanent soil nutrients.
Dorneanu (1984) quoted Borlan et al. (1994), established the main qualities of humus: incorporating over 90% of total nitrogen content; 35-65% of total phosphorus content; in soils desalted up to 70% of the sulfur; provides energy and chemical substances necessary interim plastic bodies that make up the soil micro flora and fauna; contribute significantly to the orderly aggregation of mineral particles and their structural organization into the ground. Also humic substances interact with colloidal clay forming clay-humic complex.
Under natural conditions not influenced by fertilizers application mineralization of soil organic matter under the influence of microorganisms lead to mineral nitrogen compounds. Climatic factors in particular temperature and humidity strongly influences the activity of microorganisms and the formation of ammonia, nitrite and nitrate in the soil by mineralization of humic substances has its own dynamics during the year, which is dependent on weather conditions.
The formation of the clay-humus complex between humic substances and clay minerals is also influenced by the nature of the surface of the clay cation exchange, the pH of the medium and ionic strength, the molecular weight of the species of humic substances and clay minerals.
Since plant resources into the soil, is the most accessible source of microbial metabolism in soil, much of it (60-70%) will be consumed in respiratory processes, only an amount of 30-40% will go into the compound structure of humic and it is known as the coefficient of humification or izohumic coefficient (Dodocioiu et al., 2009).
The content of humus in the soil is influenced by the ratio C/N, the amount of humus is all the more higher as the C/N ratio is small, while the C/N value takes place over 22 to 24.
The mineralization and the decrease of humus content (Rusu et al., 2005).
Experimental data obtained after many years standing experiences from their start indicates a differentiation of humus content in arable layer between variants fertilized every year and the unfertilized control. This differentiation occurs as a result of higher annual rates of decline of humus content in the soil fertilized than in

fertilized. The experimental data and mathematical models developed on the basis.

It highlights their tendency soil system to evolve towards equilibrium states amplitude modification of humus content in the arable layer is decreased increasingly more.

The humus content tends toward "equilibrium level" and is significantly higher than under conditions of balanced fertilization when not fertilize (Borlan et al., 1998).

Table 1 presents the analytical results regarding the influence of phosphorus fertilization for each variant on humus content. The humus content increased by 0.49% to P_{80} application; 0.51% to 0.61% in P_{120} and P_{160} kg/ha.

Table 3 presents the combined influence of applying nitrogen and phosphorus.

They found significant increases, significantly distinct and very significant to 0.84% compared to the unfertilized control. After nitrogen fertilization experimental field was found that it did not bring significant changes humus content regardless of the applied dose. Significant changes were significant and distinctly highlighted the application of phosphorus.

Table 1. Influence of phosphorus on the humus content of soil

No.	Phosphorus Mean (%)	Content	Control (%)	Diff. Control (%)	Semnif.
1	P_0	3.66	100	0	Control
2	P_{40}	3.96	108.23	0.3	-
3	P_{80}	4.15	113.28	0.49	*
4	P_{120}	4.17	113.94	0.51	**
5	P_{160}	4.27	116.8	0.61	**

Table 2. Analytical results on fertilization with nitrogen and phosphorus on the cation exchange properties

Agrofond	SB (%)		Ah (me/100g sol)		V (%)		T (me/100g sol)	
	Average	Semnif.	Average	Semnif.	Average	Semnif.	Average	Semnif.
N_0P_0	22.66	Control	5.98	Control	79.69	Control	29.54	Control
$N_{40}P_0$	22.84	0.18 ns	6.17	0.19 ns	78.75	-0.93 ns	29	-0.54 ns
$N_{80}P_0$	23.59	0.93 ns	6.09	0.11 ns	79.41	-0.28 ns	29.69	0.14 ns
$N_{120}P_0$	21.99	-0.67 ns	7.56	1.58 oo	74.39	-5.29 ns	29.55	0.01 ns
$N_{160}P_0$	22.33	-0.33 ns	8.08	2.10 ooo	73.43	-6.26 ns	30.42	0.87 ns
N_0P_{40}	24.28	1.62 ns	5.76	-0.22 ns	80.79	1.09 ns	30.03	0.49 ns
$N_{40}P_{40}$	23.94	1.28 ns	6.25	0.27 ns	79.24	-0.44 ns	30.19	0.65 ns
$N_{80}P_{40}$	24.04	1.38 ns	6.53	0.55 ns	78.6	-1.09 ns	30.56	1.02 ns
$N_{120}P_{40}$	22.74	0.08 ns	7.62	1.64 oo	74.87	-4.82 ns	30.36	0.82 ns
$N_{160}P_{40}$	22.42	-0.24 ns	7.65	1.67 oo	74.5	-5.19 ns	30.07	0.53 ns
N_0P_{80}	23.24	0.58 ns	6.05	0.07 ns	79.32	-0.37 ns	29.29	-0.25 ns
$N_{40}P_{80}$	24.33	1.67 ns	6.64	0.66 ns	54.56	-25.13ooo	30.97	1.42 ns
$N_{80}P_{80}$	24.22	1.56 ns	6.29	0.31 ns	78.46	-1.23 ns	30.87	1.33 ns
$N_{120}P_{80}$	23.74	1.08 ns	7.68	1.70 oo	76.08	-3.60 ns	31.2	1.66 *
$N_{160}P_{80}$	23.60	0.94 ns	7.78	1.80 oo	75.21	-4.48 ns	31.39	1.84 *
N_0P_{120}	24.70	2.04 ns	6.17	0.19 ns	79.99	0.29 ns	30.87	1.33 ns
$N_{40}P_{120}$	24.97	2.31 *	5.99	0.01 ns	79.43	0.26 ns	31.77	2.23 **
$N_{80}P_{120}$	24.59	1.93 ns	6.5	0.52 ns	79.09	-0.60 ns	31.1	1.56 ns
$N_{120}P_{120}$	24.59	1.93 ns	8.24	2.26 ooo	76.08	-3.61 ns	32.34	2.79 ***
$N_{160}P_{120}$	23.74	1.08 ns	6.71	0.73 ns	76.71	-2.98 ns	30.93	1.39 ns
N_0P_{160}	25.41	2.75 *	5.89	-0.08 ns	81.09	1.39 ns	31.3	1.76 *
$N_{40}P_{160}$	25.48	2.82 **	5.61	-0.36 ns	80.99	1.30 ns	31.45	1.91 *
$N_{80}P_{160}$	25.38	2.72 *	8.28	2.30 ooo	76.82	-2.87 ns	33.05	3.50 ***
$N_{120}P_{160}$	25.04	2.38 *	6.96	0.98 ns	78.25	-1.44 ns	32	2.45 **
$N_{160}P_{160}$	24.42	1.76 ns	7.51	1.53 oo	76.51	-3.18 ns	31.93	2.39 **
	LSD 5%	2.07	LSD 5%	1.04	LSD 5%	14.05	LSD 5%	1.6
	LSD 1%	2.76	LSD 1%	1.39	LSD 1%	18.74	LSD 1%	2.13
	LSD 0.1%	3.60	LSD 0.1%	1.81	LSD 0.1%	24.47	LSD 0.1%	2.78

Table 3. Analytical results on fertilization with nitrogen and phosphorus on the humus content and pH

Agrofond	pH		Humus (%)	
	Average	*Semnif.*	*Average*	*Semnif.*
N_0P_0	5.96	Control	3.72	Control
$N_{40}P_0$	5.65	-0.30 oo	3.36	-0.36 oo
$N_{80}P_0$	5.75	-0.20 o	3.42	-0.30 o
$N_{120}P_0$	5.46	-0.49 ooo	3.83	0.2 ns
$N_{160}P_0$	5.33	-0.62 ooo	3.96	0.24 ns
N_0P_{40}	5.73	-0.22 o	3.66	-0.06 ns
$N_{40}P_{40}$	5.69	-0.26 oo	3.82	0.10 ns
$N_{80}P_{40}$	5.54	-0.41 ooo	4.02	0.30 *
$N_{120}P_{40}$	5.43	-0.52 ooo	3.86	0.40 ns
$N_{160}P_{40}$	5.35	-0.60 ooo	4.44	0.72 ***
N_0P_{80}	5.54	-0.41 ooo	4.26	0.54 ***
$N_{40}P_{80}$	5.64	-0.31 oo	4.00	0.28 *
$N_{80}P_{80}$	5.58	-0.37 ooo	4.00	0.28 *
$N_{120}P_{80}$	5.41	-0.54 ooo	4.20	0.48 ***
$N_{160}P_{80}$	5.37	-0.58 ooo	4.26	0.54 ***
N_0P_{120}	5.74	-0.21 o	4.20	0.48 ***
$N_{40}P_{120}$	5.62	-0.33 ooo	4.08	0.36 **
$N_{80}P_{120}$	5.58	-0.37 ooo	4.14	0.42 **
$N_{120}P_{120}$	5.39	-0.56 ooo	4.26	0.50 ***
$N_{160}P_{120}$	5.43	-0.52 ooo	4.16	0.44 **
N_0P_{160}	5.76	-0.19 o	4.15	0.43 **
$N_{40}P_{160}$	5.65	-0.30 oo	4.08	0.36 **
$N_{80}P_{160}$	5.45	-0.50 ooo	4.56	0.84 ***
$N_{120}P_{160}$	5.60	-0.35 ooo	4.26	0.54 ***
$N_{160}P_{160}$	5.40	-0.55 ooo	4.32	0.60 ***
	LSD 5%	0.19	LSD 5%	0.27
	LSD 1%	0.26	LSD 1%	0.35
	LSD 0.1%	0.34	LSD 0.1%	0.47

CONCLUSIONS

Long-term differentiated fertilization phosphorus and nitrogen on the Cambic Phaeozem from Teleorman had the following effects after 39 years:

• The application of nitrogen fertilizers in the experimental field no changes were made statistically significant in humus content regardless of the applied dose. Significant changes were significant and distinctly highlighted the application of phosphorus was found an increase of 0.49% humus content of the application P_{80}; 0.51% to 0.61% in P_{120} and P_{160} kg/ha.

• Nitrogen applied in doses of 120-160 kg N/ha resulted an increase from unfertilized acidity hydrolytic 1.64 with 1.57 to me/100g soil, applying nitrogen fertilizer with phosphorus were associated with a decrease in the amount bases from -0.43 to -0.75 me/100 g soil, thus decreasing the degree of saturation in bases -4.23 to -4.90%.

• The total cation exchange capacity (T) has experienced significant growth and significant distinct phosphorus application rates from $P_{120-160}$ kg/ha.

• Nitrogen fertilizers of ammonium nitrate, causing a drop of soil reaction depending on the applied dose of 0.29 to 0.37 pH units from 5.75 weakly acidic to moderately acidic unfertilized control to 5.37, 120 and 160 kg N/ha, the decrease was very significant soil reaction and reached levels that require the application of amendments calcareous soil. The doses of phosphorus did not bring significant changes in soil reaction.

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