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PEDOLOGICAL AND AGROCHEMICAL STUDY IN THE RADU VODĂ AND LUPȘANU AREA, CĂLĂRAȘI COUNTY, COVERING AN AREA OF 500 HA, WITH THE DEVELOPMENT OF A FERTILIZATION PLAN FOR CROPS

Marian MUȘAT[1], Lavinia BURTAN[2], Mihaela Valentina VASILE[1], Oana Alina NIȚU[1], Amelia ANGHEL[2]

[1]*University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd., District 1, Bucharest, Romania, author email: dr_marianmusat@yahoo.com; mihaelapetcu2505@yahoo.com; oanaalinanitu1111@yahoo.com*
[2]*National Research and Development Institute for Soil Science, Agrochemistry and Environment - ICPA Bucharest, 61 Mărăști Blvd., District 1, Bucharest, Romania*
author email: *lavinia.burtan@icpa.ro*

Corresponding author email: lavinia.burtan@icpa.ro

Abstract

This study is the subject of research contract no. 378/04.02.2025, concluded between USAMV in Bucharest and SC LUXCOM SRL, regarding the soil and agrochemical mapping in the Radu Vodă and Lupșanu area, Călărași County, aimed at identifying and characterizing the dominant soil type and developing a fertilization plan for crops.
The pedoclimatic conditions are specific to the plain area (Central Bărăgan) on the interfluve between Ialomița and Mostiștea, with a temperate climate of the Bsax type (Koppen, 1936).
Soil profiles and control surveys were performed in different plots from which soil samples were collected both in natural and disturbed conditions, according to the Guide for field description of soil profiles and specific environmental conditions (Florea and Munteanu, 2009).
From each plot, average agrochemical samples were collected according to the INCDPA-PM instructions, these being conditioned in the laboratories of USAMV in Bucharest and analyzed by the company SC Cartare agrochimică SRL.
Based on the results obtained, a fertilization plan was drawn up for the crops, depending on the expected yield, the nutrient reserve in the soil, and the preceding crop, with the entire area being arranged for irrigation (drip and sprinkler).
***Key words**: soil mapping, typical chernozem, agrochemical mapping, fertilization plan*

INTRODUCTION

Soil is the main means of production in agriculture (13.1 billion hectares of the globe being land, of which 1.5 billion hectares are used for agriculture, returning 1.1 hectares of agricultural land per capita of the Earth and only 0.67 hectares of agricultural land per capita in our Country) Limited in scope but also in terms of production potential (Rauta et al., 1983).

UNEP (1982) defined soil degradation as follows: reducing the current and/or potential capacity of soil to produce quantitative and qualitative goods or services as a result of the presence of one or more negative degradation processes.

Soil degradation has been accentuated more and more strongly by changes in land use since the 18th century (Richards, 1990). The most widespread processes of soil degradation are: anthropogenic or secondary compaction (44%), natural or primary deep-water compaction (14%), water and wind erosion (47%), drought (48%), temporary excess water (25%), low humus reserve (50%), low accessible phosphorus content (42%) and acidity State (23%) (Marinca et al., 2009).

FAO data show that the agricultural area is estimated at 1475 million ha; the area affected anthropically, by technologies is 552 million ha, to these are added another 10 million ha agricultural land affected by industrial activities in Europe, which means that the total degraded area reaches 562 million ha (38% of the agricultural area) of which 285 million ha is moderately degraded. In Europe, the most affected areas are the Mediterranean, where the decrease in organic matter, organic carbon content in the soil is one of the most important causes of other forms of soil degradation. It has been estimated that in southern Europe, CA. 75% of the area has low organic matter content (3.5% W/W) and very low (1.7% w/w). Soil degradation through the decline of chemical and physical fertility requires the increase of the organic matter content necessary to improve soil fertility, nutrient cycle, soil structure in order to ensure sustainable agriculture in the future (Swift, 2001).

In the agrarian policies of different countries, especially in the last 50-60 years, huge efforts have been made to modernize agriculture, to increase productivity, to raise the contribution of Agriculture to the economic development of each country, but it was precisely this that was accompanied by numerous negative effects on the soil and the environment. Agriculture, in the future, should be based on harmonious biophysical principles that are in line with the requirements and needs of the farmer community. Some of the requirements refer to a sustainable system of maintaining the' health " of the soil, more efficient use of water from precipitation,fertilizers and erosion prevention (Dumitru Elisabeta, 2005).

Healthy soils are an essential prerequisite for meeting the varied demands of food, fiber, feed and other products, as well as ensuring the provision of essential ecosystem services in all regions of the world. However, humankind is facing unprecedented pressures on soil resources in particular, soil degradation of various types, including tiredness produced by rapid urbanization, causes suffering threatening food security and ecological balance (World Soil Charter (WSC) 2015). Population growth means an increase in the demand for food in the world, while essential factors in food production, such as cultivated land or drinking water, sacd continuously amplified against the background of global warming, which will lead to a steady decline in yields (Topa et al., 2018).

Truly sustainable agriculture has as its main objective the optimization of productivity, but at the same time the conservation of basic natural resources, which means that in agricultural production systems the balance between imputations and outputs, between investments and benefits will be preserved, under the conditions of ensuring the quality of the environment and promoting, overall, a sustainable economy (Burtan Lavinia et al., 2016).

MATERIALS AND METHODS

The paper aims to develop a pedological and agrochemical study in order to develop the fertilization plan on crops, in total area of 500 ha, in Calarasi County. The soil type is represented by typical Chernozem.

Two soil profiles were performed, morphologically described and physicochemically analyzed in the laboratory.

1) Soil sampling

Methods of analysis used to determine chemical characteristics:

Organic matter (humus): determined volumetric by wet oxidation method after Walkley-Black, in Donut modification-STAS 7184/21-82;

$CaCO_3$ (carbonates): gasometric method using the Scheibler calcimeter, after SR ISO 10693: 1998 (%);

The nitrogen content was determined indirectly (by calculation) based on the

humus content and the degree of saturation with bases;
IN = humus x V / 100;
Accessible phosphorus (mobile P): after the Egner-Riehm-Domingo method and colorimetrically dosed with molybdenum blue, after the Murphy-Riley method (reduction with ascorbic acid);
Accessible potassium (K): extraction by Egner-Riehm-Domingo method and dosing by Flame photometry;
pH: potentiometrically determined, with combined glass and calomel electrode, in aqueous suspension at the soil/water ratio of 1/2. 5 - SR 7184/13-2001;
Hydrolytic acidity - extraction with sodium acetate at pH 8.2;
Sum of bases - Kappen Schoffield method by extraction with normal 0.05 hydrochloric acid.
Methods of analysis used to determine physical characteristics:
Determination of granulometric fractions:
• pipette method for fractions of 0.002 mm;
• wet sieving method for fractions 0.002-0.2 mm and dry for fractions > 0.2 mm. The results are expressed as a percentage of the material remaining after pretreatment.
Bulk density (DA): method of metal cylinders of known volume (100 cm3) at momentary soil moisture (g/ cm3);
Total porosity (PT): by calculation (%by Volume - % v/v);
Aeration porosity (PA): by calculation (%by Volume - % /v);
Degree of subsidence (GT): by calculation GT = [(PM-PT – / PMN] x 100 (% of Volume - % v / v), in which: PMN-minimum total porosity required, varied according to the clay content of the respective sample, is calculated with the formula PMN = 45+0.163 A (% of Volume -% v/v); PT = total porosity (% v/v); A – clay content (% w/w);
Hygroscopicity coefficient (CH): drying at 105 kg C of a soil sample previously moistened at equilibrium with an atmosphere saturated with water vapor – in the presence of a solution of H2SO4, 10%) - % by weight (%w/w);
Withering coefficient (CO): by calculation, by multiplication by 1,5 of the hygroscopicity coefficient, determined by the modified Mitscherlich method (without vacuum, with blank sample) – % by weight (% w/w).
Initial soil moisture (wi): by drying the soil sample in the etuve at a temperature of 1050 C (weight % compared to dry soil at 1050C); *Field capacity for water* (CC): BY estimation based on texture and apparent density, according to the "Methodology of development of Pedological studies", ICPA, 1987.

RESULTS AND DISCUSSIONS

2) Characterization of the soil cover in the studied area

Profile no. 1 (Figure 1).

Typical chernozem (CZ-ti); geographical coordinates: N: 44022'34" and E: 26056'43". Relief: plain; use: arable, corn (3-4 leaves); rock: loessoid deposits; ground water: >10. m.

Figure 1. Profile Radu Voda, Calarasi

Morphological characterization of Profile 1

Am (0-48 cm), dusty clay, dark brown (10 YR 2/2 to wet and 10 YR 3/3 to dry), well developed glomerular structure, jilav, porous, permeable, frequent fine roots from cultivated vegetation, weak effervescence at the base of the horizon;

AC (48-84 cm), medium clay, light brown (10 YR 3/3 to wet and 10 YR 4/4 to dry), poorly developed glomerular structure in the upper half of the horizon, slightly friable, porous, loose, with accumulations of carbonates in the form of pseudomycelia, moderate effervescence;

Cca (84-120 cm), sandy clay, dusty, yellowish (2,5 Y 5/3 to wet and 2,5 Y 6/4 to dry), unstructured, very friable, porous, loose, carbonate accumulations in the form of pseudomycelia and small crumbly concretions, very strong effervescence.

Profile no. 2 (Figure 2).

Typical chernozem (CZ-ti); geographical coordinates: N: 44029'52" and E: 26015'12". Relief: plain; use: arable, corn (3-4 leaves); rock: loessoid deposits; ground water: >10 m.

Figure 2. Profile Lupșanu, Calarasi

Morphological characterization of Profile 2

Am (0-46 cm), dusty clay, dark brown (10 YR 2/2 to wet and 10 YR 3/3 to dry), glomerular structure well developed, jilav, porous, permeable, frequent fine roots from cultivated vegetation, beginning of hard-pann at 35-45 cm, weak effervescence at the base of the horizon, gradual transition to the lower horizon;

AC (46-78 cm), medium clay, light brown, (10 YR 3/3 to wet and 10 YR 4/4 to dry), poorly developed glomerular structure in the upper half of the horizon, slightly friable, porous, loose, with accumulations of carbonates in the form of pseudomycelia, moderate effervescence;

Cca (78-130 cm), dusty sandy clay, yellowish (2.5 Y 5/3 in wet and 2.5 Y 6/4 in dry), unstructured, very friable, porous, loose, accumulations of carbonates in the form of pseudomycelia and small crumbly concretions, very strong effervescence.

C (130-176 cm), medium sandy loam, yellowish (2.5 Y 5/4 to wet and 2.5 Y 6/6 to dry), unstructured, very friable, porous, small crumbly concretions, strong effervescence.

Development of the fertilization plan

The fertilization plan was drawn up based on the results obtained from the field, regarding the supply of nutrients, soil reaction, humus content, etc., of the crops in rotation, especially the previous plant and the expected (planned) harvest. Unlike other areas studied, the pedoclimatic conditions are very favorable, the technology applied to crops is of a higher level, the systems of works are alternating (classical and unconventional) and most importantly, the entire exploited area is arranged for irrigation (drip and sprinkler).

When determining the types and doses of chemical fertilizers, ICPA indications were used, which correlated the results from long-term experiences with fertilizers on different soil types with the agrochemical indices characteristic of these soils and the evolution of agrochemical fertility. The recommended doses are expressed in the active substance, being correlated (converted) to crude fertilizers, depending on their content in the active substance.

Results of agrochemical analyses based on samples collected from the area of 500 ha, (320 ha Radu Voda and 180 Lupsanu), are presented in table and agrochemical recommendations on application of fertilizer doses on crops, are presented in Table 4. The texture of this soil unit is loamy (middle) undifferentiated, throughout the depth of the soil profile;

The main limiting factor of the production potential is the deficient rainfall during the vegetation period, which is partially compensated by irrigation.

Analytical data for typical chernozem in the studied areas are presented in the tables below.

Table 1. *Physical and chemical analysis for typical chernozem*

Horizon	Am	AC	Cca	C
Depth (cm)	0-48	48-84	84-120	120-165
Sand gr. (2-0. 2 mm)	8,2	13,9	10,3	14,3
Fine sand (0.2-0.02 mm)	25,8	30,2	29,6	34,8
Dust (0.02-0.002 mm)	37,6	29,4	38,5	31,2
Clay (< 0.002 mm)	28,4	26,5	21,6	19,7
Texture	LP	LL	SS	SM
pH	7,04	7,65	8,38	8,27
Humus (%)	4,22	2,14	0,79	0,21
Bulk density (g / cm^3)	1,26	1,29	1,32	1,37
Total porosity (%)	54	52	50	49
Degree of subsidence GT (%)	netted	netted	weak	weak
Carbonates (%)	0,4	2,5	12,2	9,5
V (%)	92	96	100	100
IN	3,8	0,92	0,79	0,21
Mobile P (ppm)	22	11	7	-
K mobile (ppm)	181	163	142	-
Wilting coefficient %	10,8	10,2	9,8	-
Field capacity %	19,6	18,5	17,8	-
Useful water capacity %	8,8	8,3	8,0	-
Total capacity (%)	42	40	38	-
Humus Reserve (t / ha)	255	99	37	-

Table 2. *Physical and chemical analysis for typical chernozem*

Horizon	Am	AC	Cca	C
Depth (cm)	0-46	46-78	78-130	130-176
Sand gr. (2-0. 2 mm)	9,3	18,2	15,4	23,6
Fine sand (0.2-0.02 mm)	24,8	26,5	27,5	30,4
Dust (0.02-0.002 mm)	39,2	29,9	38,6	28,7
Clay (< 0.002 mm)	26,7	25,4	18,5	17,3
Texture	LP	LL	SS	SM
pH	7,8	7,15	8,35	8,57
Humus (%)	3,59	2,11	0,87	0,25
Bulk density (g / cm^3)	1,26	1,28	1,34	1,38
Total porosity (%)	54	53	49	48
Degree of subsidence GT (%)	netted	netted	weak	weak

Carbonates (%)	0,2	1,8	12,4	7,5
V (%)	98	100	100	100
IN	3,51	2,11	0,87	0,25
Mobile P (ppm)	25	11	7	-
K mobile (ppm)	200	169	147	138
Wilting coefficient %	10,6	10,2	9,9	-
Field capacity %	19,3	18,5	18,0	-
Useful water capacity %	8,7	8,3	8,1	-
Total capacity (%)	42	41	36	-
Humus Reserve (t / ha)	208	86	61	-

Table 3. Chemical analyses of soil from Radu Voda and Lupsanu, Calarasi

Area/ Physical Block	Specification					
	pH	Humus (%)	Phosphorus (mg/kg)	Potassium (mg/kg)	IN (%)	V (%)
Radu Vodă (BF-826)	7,20	3,98	40	258	3,82	96
Radu Vodă (BF-826)	7,58	4,17	56	272	4,08	98
Radu Vodă BF-826)	7,58	3,89	77	300	3,81	98
Radu Vodă (BF-826)	6,87	4,12	52	200	3,87	94
Radu Vodă (BF-826)	6,68	4,23	46	195	3,93	93
Radu Vodă (BF-826)	6,76	4,26	50	186	4,0	94
Lupşanu (BF-879)	6,94	4,22	49	184	4,0	95
Lupşanu (BF-879)	7,20	3,90	51	255	3,74	96
Lupşanu (BF-879)	7,73	3,84	53	209	3,84	100
Lupşanu (BF-879)	7,17	4,11	45	262	3,94	96

Table 4. Recommendations on doses of chemical fertilizers based on agrochemical analyzes

BF	Surface (ha)	Early culture	Current culture	Harvest (kgha)	N (kg s.a./ha)	P_2O_5 (kg s.a./ha)	K_2O (kg s.a./ha)
BF-826	80	Grau	Porumb	12 500	220	120	100
BF-826	30	Grau	Rapiță	4 000	210	160	120
BF-826	96	Porumb	Grâu	8 500	220	100	80
BF-826	35	Grau	Soia	4 500	120	100	90
BF-826	40	Grau	Porumb	12 500	220	120	100
BF-826	39	Grau	Porumb	12 500	210	110	100
BF-879	37	Rapiță	Grâu	8 500	230	100	80
BF-879	75	Fl. s.	Grâu	8 500	230	100	80
BF-879	23	Orz	Porumb	12 000	220	120	100
BF-879	45	Grâu	Fl.s.	4 000	140	110	80

Table 5. Soil reaction classes

Range pH	***Significance***	***Color on the cartogram***
< 5.00	Strongly acidic	***Dark red***
5.10-5.80	Moderately acidic	*Light red*
5.81-6.80	Weakly acidic	*Yellow*
6.81-7.20	Neutral	*Green*
7.21-8.40	Weakly alkaline	*Light blue*
> 8.40	Moderately alkaline	***Dark blue***

Table 6. Nitrogen supply (IN, %)

Range IN	*Significance*	*Color on the cartogram*
< 2,00	Lean	Light red
2.1-4.0	Middle	Yellow
4.1-6.0	Good	Light blue
> 6	Very good	Dark blue

Table 7. Interpretation of humus content (%)

Limits	*HUMUS*
2.1-3.0 3.1-4.0	Average content
4.1-5.0 5.1-8.0	Good content
>8	Very good content

Table 8. Mobile phosphorus content classes (extractable in lactate acetate)

Phosphorus	***Significance***	***Color on the cartogram***
< 8.0	Very weak	Dark red
8.1-18.0	Lean	Light red
18.1-36.0	Middle	Yellow
36.1-72.0	Good	Light blue
> 72	Very good	Dark blue

Table 9. Mobile potassium content classes (extractable in lactate acetate)

Potassium	***Significance***	***Color on the cartogram***
<66	Lean	Light red
66,1-132,0	Middle	Yellow
132,1-200,0	Good	Light blue
>200	Very good	Dark blue

CONCLUSIONS

Fertilization for corn: in spring, 50-60 kg N/ha of complex fertilizers NP (1:2 or 1:1) / NPK (1:2:1 or 1:1:1) will be administered, with sowing, one at a time, 5-10 cm sideways from the sowing row and 5-6 cm below the seed level), and the difference in the nitrogen dose is administered at the execution of the slingshot with the cultivator.

Fertilization in wheat / barley: phosphorus and potassium are applied in full in autumn with plowing; complex NP/NPK fertilizers are used; nitrogen is applied in three stages*:*

- the first stage is recommended to take place in autumn, until the twinning period, when the fertilizer requirement is relatively low; nitrogen being readily soluble, it is recommended to apply an amount of 30-40 kg N / ha, and the rest of the fertilizers to be applied in winter or spring, depending on the evolution of the crop and the amount of precipitation fallen in the autumn-winter season; in autumn, nitrogen fertilizers can be applied before or after sowing, but too much fertilizer should not be applied, as there is a risk of leaching (precipitation acts on fertilizers).

- the second stage of wheat fertilization takes place in early spring and about 40-60 kg N/ha is applied; in order to complete the economically optimal dose of nitrogen, nitrocalcar should be used in spring, in order to avoid acidification;
- the third stage of fertilization should be carried out at the appearance of the first node of the stem when the remaining amount of the recommended dose is applied.

Rape fertilization: in autumn, before sowing, NP/NPK complexes will be administered; when applying nitrogen in autumn, we take into account the amount of plant residues from the previous plant; their presence generates a lack of N, because the bacteria responsible for the nitrification process consume nitrogen before it is taken over by plants; thus, the nitrogen dose is increased by 5-7 kg / t of plant residues; however, in autumn, a quantity of more than 50 kg S.a.N/ha will not be administered, in order to avoid nitrogen leaching and weakening of the frost resistance of plants due to intense growth; until entering winter, normally developed rapeseed plants absorb around 40 kg N/ha; on these soles, in spring, to complete the economically optimal dose of nitrogen will be applied the remaining amount in the form of nitrocalcar; the application of sulfur in spring is very important, with the fraction of nitrogen, and before flowering it is necessary to administer boron and magnesium.

Fertilization in Sunflower: it is sensitive to both the deficit and the excess of nitrogen, especially in the early stages, which will have negative repercussions on the growth and development processes; the effect of nitrogen deficiency can be seen with the advancement in vegetation of plants, which have aging leaves, yellow color, and when harvesting presenting small calatids with many dry seeds; it has a well-developed root system, is able to explore a large volume of soil, absorbing leached nitrogen, finding that the plant capitalizes quite little nitrogen from fertilizers; during the flowering period, it records a consumption of at least 3-4 kg nitrogen /ha/day, late nitrogen absorption failing to correct the effects of the deficiency in the early phases; excess nitrogen can harm the sunflower crop, causing; at the same time, the excess of nitrogen causes a lush growth of plants, prolongs the vegetation period at the expense of production and oil content, and also decreases the resistance of plants to attack pathogens and drought.

The administration of nitrogen doses calculated for sunflower culture is administered in two stages, namely: one half of the total amount, when preparing the seedbed or simultaneously with sowing and the rest of the amount is administered during mechanical slingshots (in the form of NP/NPK).

The calculated doses may be reduced by 0,75 – 1,5 kg for each tonne of manure administered to the preceding plant or directly to the crop concerned.

Phosphorus administration is carried out in summer or autumn, before the basic plowing, for a good incorporation, but 1/3 of the dose, can be applied to the preparation of the seedbed or simultaneously with sowing, thus favoring stronger rooting of plants giving them a higher resistance to drought.

The administration of potash fertilizers can be done in autumn (under plowing) with potash salt or applied to the preparation of the seedbed or simultaneously with sowing, in the form of complex fertilizers of NPK type.

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