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# PEDOLOGICAL AND AGROCHEMICAL STUDY ON THE AREA IN PERIȘORU AREA, CĂLĂRAȘI COUNTY

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***Abstract***

*The pedological mapping was carried out in order to identify the soil type and assess its fertility based on physico-chemical characteristics. At the same time, agrochemical samples were collected from the arable horizon (0-20 cm) in order to determine the nutrient content. The main physical characteristics were determined, based on the collection of soil samples in natural settlement (metal cylinders). Based on the nutrient content, the crop fertilization plan was developed for each species and the expected production. Based on the results obtained, the humus content of the soil shows low values (less than 4%) unsuitable for a typical chernozem formed in the Baraganului area. A bonitation study was conducted for arable use, the soil being classified at the lower limit of Class II with 66 bonitation points, due to the less favorable climatic conditions and the phreatic level located below 10 m depth.*

***Key words**: improvement, soil cover, fertilization plan, agricultural technologies.*

## INTRODUCTION

When it is stated that the fertility of a soil has decreased, the reference is made to its initial level, as for example to the natural fertility or fertility that the soil, already taken in culture, had years ago. The fertility of such a soil can be improved by knowing its characteristics well, as well as how they can be influenced by agro-pedo-ameliorative measures (Budoi et al., 1996).

The arable area for every human being of the planet was valued in 1990 at 0.3 ha, reaching 0.25 ha in 2000, estimated at 0.15 ha in 2050 and at only 0.10 ha in 2150, so that the requirements of mankind could be met only by innovative scientific technologies (Lal, 1992).

FAO data showed 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 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 Romania, the most widespread soil degradation processes are: anthropogenic or secondary compaction (44%), water and wind erosion (47%), drought (48%), temporary excess water (25%), low humus reserve (50%), low phosphorus content (42%) and acidity state (23%) (Marinca et al., 2009). The soil can no longer be satisfactorily classified according to the size of the particles of which it consists, in a few Restricted Groups: sands, loams, clays, etc., having to take into account their history. The properties of the soil depend not only on the parental material, as shown by Dokuchaev (quoted by Russel, 1973), they depend on the climate, vegetation and other factors with which they interact (Topa et al., 2013). 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). The influence of the tillage system on soil characteristics are important indicators for preserving soil fertility and assessing the sustainability of the agricultural system (Guş, 1997; Rusu, 2001; Mark et al., 2004; Jităreanu et al., 2006; Almagro et al., 2017; Biddoccu, et al., 2017; Martínez-Mena et al., 2020; 2021; Burtan et al., 2016; 2023).

## MATERIALS AND METHODS

Soil sampling agrochemical middle of plowed horizon (0-20 cm) were composed of 15-20 individual samples from the surface sampling plots of ground. The parceling of land, was considered pedological complexity, uniformity of land utilization, crop structure so that each sample representing a plot as uniform (SRTS, 2012; MESP, 1987, vol. I-III). The results were analyzed and interpreted based on the standards contained in the catalog A.S.R.O. that are consistent with international standards.

**Methods of analysis used to determine the chemical characteristics**

Organic matter (humus): determined by volumetric wet oxidation method after Walkley-Black, the change Doughnut – STAS 7184 / 21-82. Carbonates - gasometric method using calcimetrul Scheibler after SR ISO 10693: 1998 (%). Nitrogen content was determined indirectly (by calculation) based on the humus content and degree of saturation with bases.

IN = humus x V / 100.

Accessible phosphorus (P mobile): after EgnerRiehm-Domingo and dosed with molybdenum blue colorimetric after Murphy-Riley method (reduction with ascorbic acid). Available potassium (K mobile): extraction after Egner-Riehm-Domingo and determination by flame photometry.

pH: determined potentiometrically with a combined glass and calomel electrode in an aqueous suspension to the Soil / Water 1/2.5 - SR 7184 / 13-2001. The acidity of the hydrolytic - extraction with sodium acetate to pH 8.2. Amount bases - Kappen method Schoffield Chirita by extraction with 0.05 normal hydrochloric acid

**Methods of analysis used to determine the physical properties**

The bulk density (BD): the method of the metal cylinder of known volume (100 $cm^3$) to the temporary humidity of the soil ($g/cm^3$). The total porosity (TP) by calculating (% by volume - % v / v). The coefficient of hygroscopic (CH) drying at 105°C of a sample of soil moistened in advance in equilibrium with an atmosphere saturated with water vapor (in the presence of a solution of $H_2SO_4$, 10%) - % by weight (% w/w). Wiping coefficient (WC): calculated by multiplying by 1.5 the hygroscopicity factor determined by the modified Mitscherlich method (no vacuum, witness evidence) - weight %.

## RESULTS AND DISCUSSIONS

### Characterization of physico-geographical conditions

The studied territory is located in the Bărăgan Plain, a geographical subunit located in the eastern part of the Romanian Plain, is distinguished by certain specific geographical features. The southern Bărăgan is subdivided by the Argova - Vanata valleys with its tributary Furciturii Valey in three subunits: Lehliu Plain in the West (composed of Copuzeanca field, Milotina field and Andolina field); Mărculesti Plain (composed of Thistle field in the North, consisting of sands and Jegaliei field from the old Danube floodplains-Balti at the levels of terraces 4 and especially, 3 and 2) (Posea et al., 2005). Hagieni field, Calarasi-terrace field and Făcăeni field. The geomorphology of the plain is represented by smooth interfluves called Fields (Hagieni, Jegalia, Thistles, Andolina), with altitudes of 35-40 m, covered by limo-like deposits, interrupted by small depressions called “crovs” and narrow valleys of “mostiste” type, signifying a territory with arid climatic conditions and a steppe vegetation. Fields represent the major type of relief. They have a general fluvio-lacustrine origin, but locally diversified, and are covered with ligness having a thickness of 8-40 m absolute altitudes average 40-60 m. Due to its geographical location, with a wide opening towards the east, the north-eastern part of Bărăgan is characterized by a temperate zone of the plain, with a high degree of continentalism, with the contrast of the thermal high in the winter (-2°C, -4°C in January and the lowest possible until it is below 30°C) in summer (from 22°C to 23°C in July and a maximum of more than 40°C). The extreme values recorded in Mărculesti over time, were 41.5°C (Mărculesti, august 10, 1951) in the air and 68.6°C on the ground (at the same station, July 16, 1966) in the warm season and -30°C in the cold season on January 8, 1938 in the air and of -25.9°C on the ground (Posea et al., 2005). Precipitation is distributed unevenly during the year, so on average 39% of the amount of precipitation falls in the cold season, and the remaining 61% in the warm season.

Currently, in the Steppe area, the few remains of Meadows consist of bearded grass (*Botriochloa ischaemum*), steppe fescue (*Festuca valesiaca*), pir crested (*Agropyrum cristatum*), *Koeleria cristata, Phleum phleoides*, and the heavily modified ones, bulbous thread (*Poa bulbosa*), wormwood (*Artemisia austriaca*), pir gros (*Cynodon dactylon*), alior (*Euphorbia nicdeensis*) and other species adapted to dryness. The forest appears in the form of small areas, where the phlox Oak predominates (*Quercus pedunculiflora*) - Pontic species, in association with fluffy Oak (*Quercus pubescens*), mojdrean (*Fraxinus ornus*), plop (*Populus* sp.), dogwood (*Ligustrum vulgare*), turkish cherry (*Prunus mahaleb*).

Figure 1. Representative profile, Perișoru, Călărași

Steppe thickets are represented by blackthorn (*Primus spinosa*), dwarf almond (*Amygdalus nana*), cherry dwarf (*Cerasus fruticosa*), rosehip (*Rosa gallica*), stubble BlackBerry (*Rubus caesius*) etc., among which isolated specimens of elm are also found.
The soil type is represented by typical chernozem (SRTS-2012 and WRB-SR - 2014) with the following composition of Horizons: Am-AC-Cca (Figure 1).

**Morphological characteristics**
*Horizon Am (0-36 cm),* dusty clay, dark brown, (10 YR 2/1 to wet and 10 YR 3/2 to dry), glomerular structure well developed, porous, permeable, frequent fine roots from cultivated vegetation, weak effervescence at the base of the horizon, beginning of hardpan at 30-48 cm, (at the separation limit between bioaccumulative horizon and transition horizon), gradual transition to the lower horizon.
*Horizon AC (36-68 cm),* medium clay, light brown, (10 YR 3/3 in wet and 10 YR 4/4 in 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.
*Horizon Cca (68-120 cm),* sandy clay dusty, yellowish (2.5 Y 5/4 in wet and 2.5 Y 6/6 in dry), unstructured, very friable, porous, loose, with accumulations of carbonates in the form of pseudomycelia and small crumpled concretions, strong effervescence.

**Physico-chemical characterization**
The physico-chemical characteristics of this type of soil, are consistent with the formation of physical and geographical conditions thereof.
Analytical data for tipical chernozem are shown in Table 1.
Soil reaction (pH) is neutral with values of (6.56); organic matter content is medium (3.26%); bulk density (BD g/cm$^3$) is low (1.25); total porosity (%) is high (54%); degree of subsidence (GT%) is unattached with negative values. Carbonates occur at the base of the bioaccumulative horizon. The degree of saturation in bases (V%) falls within the eubase range with values between 91-100%. The nitrogen index (NI%) is medium with values of 3.02%; mobile potassium ($P_{AL}$ mg/kg) is medium with values of 151 mg/kg and mobile phosphorus ($K_{AL}$ mg/kg) with values of 23 mg/kg. Being a soil with undifferentiated loamy texture on the profile, the hydrophysical indices show favorable values for the growth and development of plants, creating a very favorable aerohydric regime. The total water capacity (TWC%) shows high values perfectly correlated by the ratio of total porosity and apparent density. The humus reserve shows medium values on the first 36 cm from the soil surface (146.7%).

Table 1. Physico-chemical analysis at soil Am-AC-Cca, of studied territory

| Horizon | Am | AC | Cca | C |
|---|---|---|---|---|
| Depth (cm) | 0-36 | 36-68 | 68-120 | 120-185 |
| Coarse sand gr. (2-0.2 mm) | 8.3 | 16.3 | 16.7 | 20.6 |
| Fine sand (0.2-0.02 mm) | 26.8 | 29.7 | 25.6 | 31.2 |
| Dust (0.02-0.002 mm) | 38.7 | 28.6 | 39.5 | 30.4 |
| Clay (< 0.002 mm) | 26.2 | 25.4 | 18.2 | 17.8 |
| Textural class | LP | LL | SS | SM |
| Reaction (pH) | 6.56 | 7.15 | 8.35 | 8.57 |
| Humus content (%) | 3.26 | 2.11 | 0.89 | 0.56 |
| Bulk density (g/cm$^3$) | 1.25 | 1.27 | 1.31 | - |
| Total porosity (%) | 54 | 52 | 48 | - |
| Degree of compaction GT (%) | uncompacted | uncompacted | weak | weak |
| Carbonates (%) | - | 6.5 | 12.9 | 12.5 |
| Percentage of base saturation (%) | 94 | 100 | 100 | - |
| Nitrogen indicator | 3.02 | 2.26 | 0.89 | - |
| Phosphorus mobile (ppm) | 23 | 19 | - | - |
| Potassium mobile (ppm) | 151 | 120 | - | - |
| Wilting coefficient (%) | 10.5 | 10.0 | 9.5 | - |
| Field capacity (%) | 19.1 | 18.2 | 17.3 | - |
| Usable water capacity (%) | 8.6 | 8.2 | 7.8 | - |
| Total capacity (%) | 43 | 41 | 36 | - |
| Humus reserve (t/ha) | 146.7 | 86 | 61 | - |

Table 2. Calculation of the crop crediting mark for typical chernozem

| Indicators | Culture | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | wheat | barley | mais | sunflower | potatoes | beet | soybeans | peas |
| Average temperature | 1.0 | 1.0 | 1.0 | 1.0 | 0.9 | 1.0 | 1.0 | 1.0 |
| Average precipitation | 0.9 | 0.9 | 0.8 | 0.9 | 0.7 | 0.7 | 0.9 | 0.9 |
| Gleization | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Stagnogleization | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Saliniz/alcalization | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Texture in 0-20 layer | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Edaphic volum | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Poluation | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Slope | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Sliding | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Growndwater | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Inundability | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Humidity | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Total porozity | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Carbonates (%) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Reaction in 0-20 layer | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Humus content | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Bonitation notes | 72 | 72 | 64 | 72 | 50 | 56 | 72 | 72 |
| *Medium UTS* | *66* | | | | | | | |

The study was carried out for the use of arable, for the eight crops according to the specific indicators (Table 2). In order to improve the physical characteristics (BD, TP, GT), but also to come up with an additional intake of nutrients, the following dose of semi-fermented manure is recommended, based on the humus content and the percentage of clay:

$$\text{Dose gg (t/ha)} = \left(15 + \frac{30}{3,6}\right).\left(1,35 - \frac{8}{26,2}\right).1 = 27.6$$

The results of analysis based on agrochemical four samples taken from the sole, as well as agrochemical recommendations on fertilizer application rates in crops, they are shown in Table 3 (a and b).

Table 3(a). Dosing recommendations of chemical fertilizers and amendments based on agrochemicals analyses

| No. | Physical block | Specification | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Reaction, pH** | **Humus content** (%) | **Phosphorus** (mg/kg) | **Potassium** (mg/kg) | **IN** (%) | **V** (%) |
| 1. | BF 6 | 7.11 | 3.69 | 62 | 326 | 3.61 | 98 |
| 2. | BF 89 | 7.63 | 3.55 | 52 | 277 | 3.55 | 100 |
| 3. | BF 84 | 7.70 | 3.46 | 49 | 278 | 3.46 | 100 |
| 4. | BF 1181 | 7.38 | 3.47 | 60 | 332 | 3.33 | 96 |
| 5. | BF 1161 | 7.67 | 3.75 | 77 | 377 | 3.75 | 100 |
| 6. | BF 1158 | 7.72 | 3.64 | 73 | 298 | 3.64 | 100 |
| 7. | BF 1116 | 6.56 | 3.80 | 62 | 263 | 3.61 | 95 |
| 8. | BF 1019 | 7.55 | 3.71 | 63 | 264 | 3.71 | 100 |
| 9. | BF 677 | 7.22 | 4.05 | 96 | 238 | 4.05 | 100 |
| 10. | BF 585 | 6.89 | 3.90 | 83 | 288 | 3.70 | 95 |
| 11. | BF 583 | 6.54 | 3.74 | 78 | 251 | 3.44 | 92 |
| 12. | BF 543 | 6.50 | 3.81 | 56 | 225 | 3.58 | 94 |

Table 3(b)

| **Physical block** | **Surface** (ha) | **Previous culture** | **Current culture** | **Production** (kg/ha) | **Nitrogen** (kg s.a./ha) | **$P_2O_5$** (kg s.a./ha) | **$K_2O$** (kg s.a./ha) |
|---|---|---|---|---|---|---|---|
| BF 6 | 91.36 | Wheat | Maize | 10 000 | 200 | 120 | 100 |
| BF 89 | 102.09 | Rape | Wheat | 8000 | 200 | 100 | 80 |
| BF 84 | 4.66 | Wheat | Wheat | 7000 | 170 | 80 | 70 |
| BF 1181 | 240.77 | Wheat | Rape | 4000 | 120 | 70 | 70 |
| BF 1161 | 112.35 | Barley | Sunflower | 4000 | 120 | 70 | 60 |
| BF 1158 | 16.80 | Wheat | Wheat | 7000 | 170 | 80 | 70 |
| BF 1116 | 91.05 | Rape | Maize | 10 000 | 210 | 120 | 110 |
| BF 1019 | 239.88 | Wheat | Maize | 10 000 | 200 | 120 | 100 |
| BF 677 | 5.33 | Rape | Barley | 7000 | 140 | 70 | 60 |
| BF 585 | 13.93 | Rape | Barley | 7000 | 140 | 70 | 60 |
| BF 583 | 18.20 | Rape | Barley | 7000 | 140 | 70 | 60 |
| BF 543 | 80.15 | Rape | Barley | 7000 | 140 | 70 | 60 |

*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 slightly 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; 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 is applied about 40-60 kg N/ha; 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.

## CONCLUSIONS

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

The soil cover of the studied area is consistent with the physical and geographical conditions of the area, being identified only one type of soil with zonal character (typical chernozem). Parental material is predominantly made up of loessoid deposits. The texture of this soil unit is loamy (middle) undifferentiated, throughout the depth of the soil profile.

The soil reaction is neutral-weakly alkaline, with pH values ranging from 6.45 to 7.72. The supply of nitrogen, represented by the nitrogen index (in) is medium, with values between 3.33 and 4.05%. The supply of mobile phosphorus is medium-high, with values ranging from 49-96 ppm. The mobile potash supply is medium-high, with values ranging from 225-377 ppm. The values of hydrophysical indices are within optimal limits, giving plants a very favorable aerohydric regime, due to the medium (loamy) soil texture, undifferentiated on the profile.

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