CONSIDERATIONS ON PHYSICAL AND CHEMICAL PROPERTIES OF TYPICAL CHERNOZEM FROM TOPRAISAR AREA, CONSTANTA COUNTY AND PROPOSALS TO IMPROVE ITS USE

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Abstract: *This paper studies typical chernozem, specifically for the Topraisar and Amzacea area, Constanta County. This soil type is characteristic for Central Dobrogea, as well as for other lowland regions of Romania. Its intense exploitation in agriculture caused changes in some certain properties. In this paper, the main properties of typical chernozem are studied. For physical, chemical and microbiological soil characterization samples from the soil profile were collected. Tthe following parameters have een determined: soil texture, soil structure in plowing and underlying horizons, the degree of compaction, soil porosity, total cationic exchange capacity, nutrients storage, pH, calcium carbonate content, organic matter content and soil microbial activity. The land evaluation marks have been also calculated for this soil type and changes in yields values due to the changes of the restrictive indicators coefficients have been highlighted. The high natural fertility of this soil, the high content of organic matter and nutrients recommended it to be used for a variety of crops cultivated in these areas. Intense exploitation in agriculture, the use of farm machinery with high weight and the execution nu e application? of soil tillage at inappropriate soil moisture, determined certain soil properties changes. The aim of this work paper was to highlighting these soil characteristics which have been modified under the influence of anthropogenic factors. The research found that, between them, the reducing of soil porosity and the increasing of soil compaction in horizons under plowed layer of soil are the main features that led to a decreasing agricultural production. Interpreting the data collected from field, laboratory test results and determining the land evaluation marks for the study area, it was concluded that the indicator which is responsible for the decrease of agricultural production is the climate conditions and the low soil porosity. This soil characteristic was induced by human activities. To eliminate the negative impacts of it, specific measures of land use have been proposed.*

Key words: *Typical chernozem, physic-chemical, soil, characterization, land use*

INTRODUCTION

Dobrogea area is represented by soils with high fertility. The main natural factor limiting agricultural production is the rainfall. Small water quantities from rainfall and long periods of drought during the summer make this area the most arid region of Romania. In this paper, in addition to natural factors, anthropogenic factors adversely influencing agricultural production have been highlighted, as well as several measures that can be taken to increase agricultural yields.

MATERIAL AND METHODS

The study was done at the SC SOFRAG AGRI Ltd., a farm covering an area of 938.67 hectares located in Topraisar and Amzacea localities. Physical, chemical and soil microbiology analysis for the soil profiles A115, located in Potârnichea village, Topraisar commune,

Constanta County, were determined at the "Analyze Microbiologique Laboratoire des Sols" Marey sur Tille – France. Morphological description of the soil profiles and the calculations of land evaluation marks were performed according to the Methodology of the soil survey ICPA (1987). The farm has its own climate statistics information for a period of five years.

RESULTS AND DISCUSSION

Due to natural conditions in the two localities predominantly occur the following soils subtypes: typical chernozem, carbonate typical chernozem, cambic chernozem. The main natural conditions are as follows: average yearly temperature: 10.5°C – 11.5°C; average annual rainfall: 400 – 500 mm, main landform: plain. Groundwater is found generally at depths greater than 10 m. The low rainfall and high temperature values lead to a decrease of the alteration process of mineral part and of leaching, conditions that favored the soil formation of chernozem. Maximum frost depth for that area is from 0.80 to 0.90 m. Groundwater levels in the area of the village is in the depth of 20.0 to 25.0 m.

Soil formation processes is characterized by intense bioaccumulation and large quantities of humus formation. Under the influence of herbaceous vegetation in conditions of poor leaching calcium mull humus is formed. Leaching has often led to calcium carbonate washing from the soil surface and easy decreasing of base complex absorption (V% is 90) without clay migration.

The main chernozem characteristic is the Cca horizon or friable powder concentration of $CaCO_3$ in the first 100 cm.

In terms of chemical and trophic characteristics (figure 1 and table 1), chernozems are ones of the most fertile soils. In the analyzed arable chernozem the following values were recorded: 3.1 to 4% humus content (figure 2), and 0.145% phosphorus and 0.186% nitrogen contents.

Chernozems are usually well supplied with nutrients (nitrogen, phosphorus, potassium and micronutrients). Chernozem reaction in the A horizon is neutral. Soil absorption complex is predominant saturated with basic cations (Ca, Mg comprise over 70% of T). The study area is represented by low carbonated typical chernozem.

Chemically speaking, the soil is rich in potassium, magnesium and calcium contents. Nitrogen content is high, as well as the phosphorus and sulphur contents. Therefore, the recommendations are to apply a good dose of nitrogen fertilizer (located application) and to reduce the phosphorus fertilizers. Microbiological activity is low in the ploughted horizon due to low soil humidity at sampling, but good in soil profile, which indicates a good supply of water at this depth.

The chernozems used as arable shows in the soil top layer profile an Ap horizon with attributes modified by tillage. Humus is calcium mull type, and C/N ratio is around 8 – 12.

Humic acids/fulvic acids ratio values are above unit and reflect hydrothermal conditions in this area.

Typically to chernozems, figure 3 shows the low percentage of rough fraction, the texture being loamy throughout the soil profile. Physical analyzes of soil horizons (figure 4), as seen in the image above, shows an important difference between compact worked soil structure and soil on the base of the profile, structured and with good porosity (figure 5).

It shows slump of higher horizons at a great depth. It is thus evident a deep compaction of the soil profile to a depth of 40 cm, due agricultural machinery waving at an inadequate soil moisture.

This compaction can be explained on one hand by the fact that the soil structure was destroyed by tillage, and on the other hand, by the lack of crop rotation with leguminous, this structure could not be recovered. Lack of fields with alfalfa is determined by the continuous decrease of the livestock and lower requirements for feed production.

Due to the soil compaction, the biological and microbiological soil activity was also significantly reduced.

In drought conditions, soil compaction is a main limiting factor of agricultural production, the soil capacity of depth water store being significantly reduced, as well as the soil water reserve.

To assess the soil suitability for different crops, land evaluation marks and classes were calculated (table 2).

The mean land evaluation mark is 58, respectively class III of favorable, indicating good conditions for wheat. From table no. 2, analysis showed that decreasing evaluation marks below 60 (the lower limit for class II of favorable) is determined under natural conditions by the compaction degree. The other under unit coefficients is represented by climatic conditions and groundwater depth, over which it could interfere with irrigation.

CONCLUSIONS

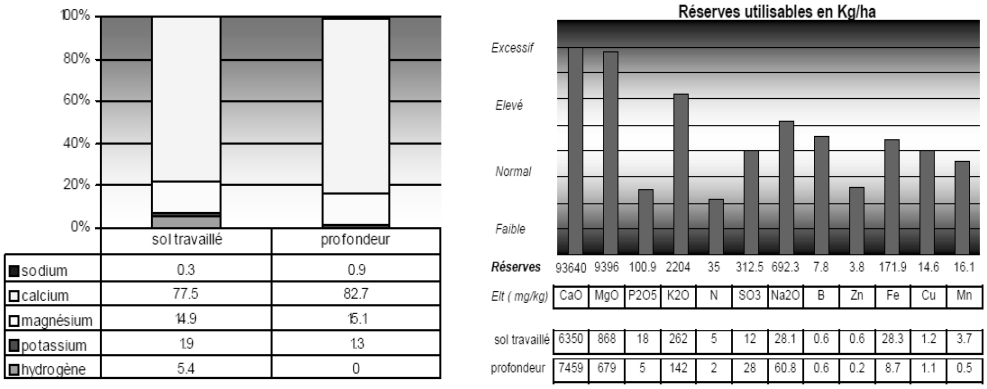
Typical chernozems are proper for all land uses and crops, but they are especially suitable for winter cereals, which capitalize water storage accumulated in fall and winter and reach full maturity before summer droughts. It could be used also for maize, sunflower, sugar beet, flax, peas, beans, alfalfa, vegetables, vines (especially table grapes) or fruit trees.

1. Topraisar village specific soils had a high content of nutrients, placing agricultural territory of the Amzacea commune in terms of the level of fertility higher than the average of Constanta County.

Although they have very good physical and chemical characteristics, due to the low rainfall regime (with periods of dryness especially during July-October), the main problem of chernozems use is the crop water supply. The compaction degree is a decrease factor of agricultural production anthropogenic induced, which reduces soil water reserve.

2. Soil water retention can be remedied by applying specific agro-technical methods based on tillage after harvest, clean land maintaining by weeds control, sowing in optimal time, crust destruction etc. Therefore, it is recommended the deep soil loosen, followed by deep-rooting plants cultivation and last but not least, the use of crop rotation with ameliorative plants for soil structure.

3. To maintain soil fertility, it is recommended the application of organic and mineral fertilizer with nitrogen, phosphorus and potassium, differentiated according to the requirements of plants, the degree of soil nutrient supply and the irrigation system.

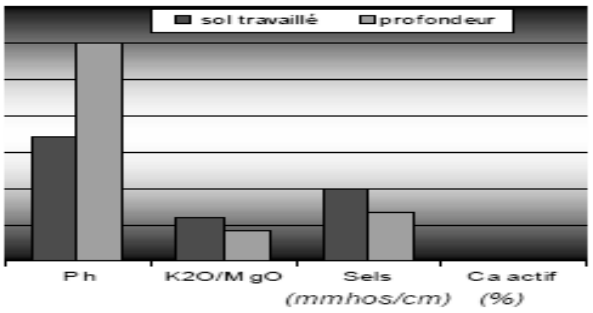


	sol travaillé	profondeur
sodium	0.3	0.9
calcium	77.5	82.7
magnésium	14.9	15.1
potassium	1.9	1.3
hydrogène	5.4	0

Réserves	93640	9396	100.9	2204	35	312.5	692.3	7.8	3.8	171.9	14.6	16.1

Elt (mg/kg)	CaO	MgO	P2O5	K2O	N	SO3	Na2O	B	Zn	Fe	Cu	Mn
sol travaillé	6350	868	18	262	5	12	28.1	0.6	0.6	28.3	1.2	3.7
profondeur	7459	679	5	142	2	28	60.8	0.6	0.2	8.7	1.1	0.5

Figure 1*a*- The main chemical soil properties



6.9	0.30	0.3	
8.6	0.21	0.2	

Figure 1*b*- The main chemical soil properties

Table 1

The chemical soil properties

Capacité d'échange en cations (Metson) meq/100

	C.E.C. Totale	C.E.C. Argile	C.E.C. MO	% MO	POINT C.E.C.
sol travaillé	29.3	18.4	10.9	3.1	3.5
profondeur	22.5	18.3	4.2	1.1	3.8

Figure 2 – The test for organic matter

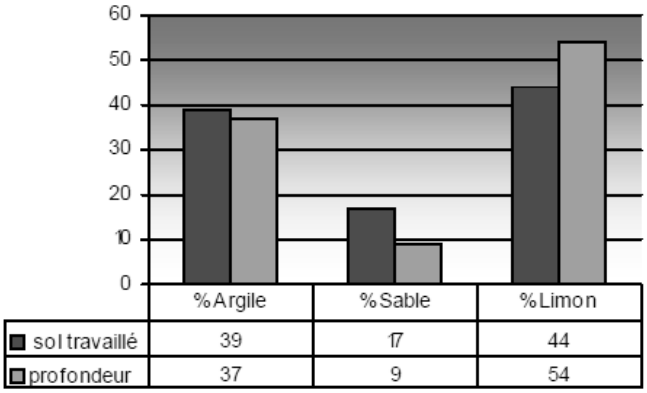


Figure 3- The soil texture

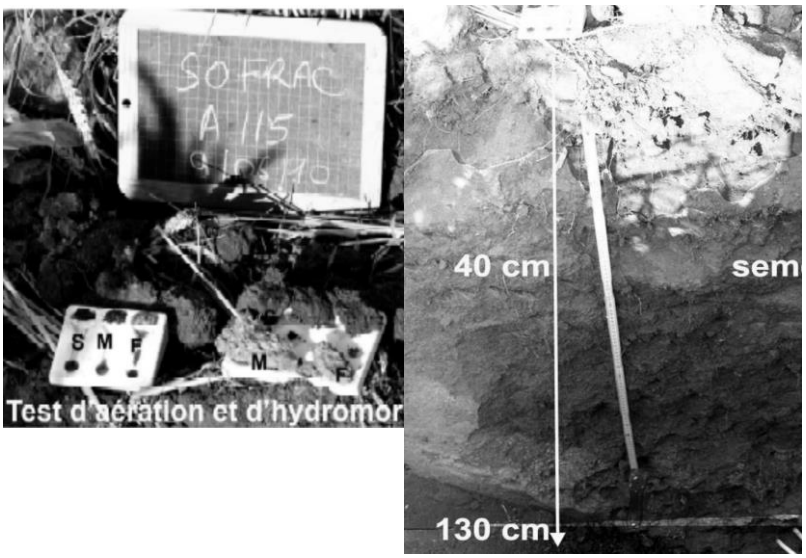


Figure 4 - The physical soil properties

Figure 5- The difference between compact worked soil structure and soil on the base of the profile, structured and with good porosity

Table 2

The land evaluation mark

Nr. crt	INDICATORS	COEFICIENT
1	Annual average temperature =11.5	1,0
2	Annual average rainfall = 350 MM	0,8
3	Gleyzation = 0	1,0
4	Salinisation = 0	1,0
5	Texture = 40	1,0
6	Pollution = 02	1,0
7	Sliding = 00	1,0
8	Flooding = 00	1,0
9	Porosity = +15	0,9
10	Groundwater =15,00	0,8
11	Calcium carbonate =06	1,0
12	pH = 8.1	1,0
13	Slope = 01	1,0
14	Useful volume soil =180	1,0
15	Humus reserve =175	1,0
Land evaluation mark for wheat		**58**
Land evaluation class - III		

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