

ANTHROPIC IMPACT STUDIES ON THE AGROCHEMICAL QUALITY CONDITION OF THE SOIL

Mariana BURCEA

University of Agricultural Sciences and Veterinary Medicine Bucharest, Faculty of Management, Economic Engineering in Agriculture and Rural Development, Calarasi Branch, 1, Nicolae Titulescu Street, Calarasi City, Romania, Phone: +40242332077, Fax: +40242332077, Mobile: +40723704868, Emails: burcea_mariana2003@yahoo.com, gideam@yahoo.com

Corresponding author: burcea_mariana2003@yahoo.com

Abstract

The quality of the soil cover due to the use of various agricultural technologies is the subject of this study. The large number of agricultural technological works that are executed under the conventional technologies can reduce the natural soil fertility by modifying the soil agrochemical indicators. These negative phenomena have led to the emergence and development of the concept called "system of agricultural works for soil conservation" [8], according to which the system of works needs to maintain or improve the productive potential of the soil. The paper presents the results of the researches carried out in order to know the effect caused by the long application of the various soil cultivation systems, on the chernozem type of Baragan Plain, soil with very high fertility potential, where the humus content is on average 3.8%. Having as comparison base the classical soil cultivation technology performed by classic plowing (conventional soil tillage), at a depth of 22 cm, various variants with low soil works were taken into consideration, namely the replacement of classical works with disc or chisel works (conservative soil tillage).

Key words: *disking, plowing, chernozem, humus, pH, total nitrogen, conservative soil tillage*

INTRODUCTION

Precision agriculture is the most advanced form of agriculture practiced in developed countries in Europe and US and consists in the involvement of modern technologies, informatics, satellites in the assessment of soil fertility indicators, vegetation factors, in inputs metering and crops protection, in the extension of new generations of agricultural technologies, soil and crops protection [3], [13].

All these requirements of agriculture have led to the introduction and development of a new concept called "system of agricultural works for soil conservation" [9], according to which the system of works should improve the productive potential of the soil.

This soil cultivation technique requires waving at the total or periodic plowing, the rationalization of the number of works and the preservation at the soil surface of at least 15-30% of the total vegetal debris, system which is applied on approx. 45% of arable surface worldwide and is projected to expand to 75% over the next 15 years [11].

MATERIALS AND METHODS

The studies and observations were made on the chernozem type soil with a dusty clay texture, 3% humus content and slightly alkaline reaction (8-8.5) in the Baragan Field, with field experiences with 3 soil work systems and the witness where the normal plowing was applied at 22 cm.

Researches were conducted under a corn crop. The soil works applied on the experimental plots were:

A - annual autumn plowing at 22 cm, (witness variant);

B – Performed in autumn over 3 years with disk harrow;

C – Performed in autumn over 3 years with the chisel;

Chemical analyses were determined in the laboratory through following methods: humus through the determination of organic carbon, pH at 1:25 in aqueous suspension was determined potentiometrically and total nitrogen (N_t) by Kjeldal method.

Determination of humus content is done through the indirect assessment of the content

because direct methods are accompanied by errors resulting from Danilic oxidation [6], so the determination of organic carbon [2] is used. Transforming the organic carbon content into humus is done by multiplying these values by a factor (1,724).

For the determination of total nitrogen, the Kjeldahl method was used, based on the wet oxidation method of organic nitrogen compounds in the soil [5].

The methodology for the elaboration of pedological studies (National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection - ICPA) indicates the limits of interpretation of the humus content and the corresponding values of organic carbon content [16], pH values and total nitrogen content [9].

The soil was researched on the 0-30 cm depth, at the corn crop, soil samples being taken from 10 cm to 10 cm.

The calculation of the experimental data was done according to the variance analysis method.

RESULTS AND DISCUSSIONS

The specific climatic conditions of the area and the technological methods of soil cultivation cause changes in the agrochemical quality of the soil.

The native soil has a moderate humus content of 3.8% on the surface, slightly decreasing in profile, reaching about 1.3% up to the depth of 1 m [15].

This type of soil has a poor alkaline reaction across the soil profile. Nitrogen soil condition in the first 20 cm is medium.

In conclusion, we can speak of a soil with a high fertility that ensures to plants a good growth and development.

Table 1. Chemical properties of chernozem soil not cultivated –Baragan Plain

Chemical properties	Horizons and depth (cm)					
	Ap 0-19	Aph 19-26	Am 26-42	AC 42-70	Ccl 70-105	Cc2 105-180
Soil reaction	7.9	8.0	8.2	8.2	8.4	8.4
Organic matter (%)	3.8	2.7	2.4	1.3	0.6	0.3
Report C: N	12.54	11.01	10.3	9.87	8.35	-
Total nitrogen (%)	0.210	0.148	0.142	0.115	-	-
Calcium carbonate (%)	0.8	3.4	7.6	10.9	17.1	15.5

Source: Own research.

After the soil analyzes carried out in the variants with various systems of soil works, the influence of the soil working method on the chemical properties of the chernozem is found. If on a native, non-worked land (Table 1) the soil humus content is in the first 20 cm of 3.8%, we notice that after the application of the technological works it has improved by using the proper crop technologies, reaching 3,9%, under the condition of soil work with the chisel or the disk [4].

Humus content in soil

If the average values of the humus content were 3,80% on the non-cultivated soil in the first 20 cm, after taking the land in the crop, and plowing the crop every year, it reached 3.35% in the year 2014, rising by 0.15% by year 2016, but keeping it below the values of unworked chernozem.

Hence we notice a significant decrease in the humus content of 0.50% when applying this technology (Table 2 and 3).

The work of soil with disk harrows determines the highest accumulation of humus, on the depth of 10-20 cm, reaching average values of 3.86%, after 3 years of works.

Table 2. The humus content modification (%) under the soil works influence, year 2014

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	3.37	3.35	3.30
The annual disk	3.30	2.98	2.85
Chisel plowgh annually	3.36	2.85	2.84
DL _{5%} (for A- soil works) = 0.04			
DL _{5%} (for B-depth) = 0.02			
DL _{5%} (for AXB) = 0.07			

*DL - the limit difference (variance analysis method)

Source: own research.

The work of soil with the chisel determines the humus content to be close to the limit values of the unworked chernozem.

The humus content is kept in all researched technological variants, on a depth of 0 - 30 cm in average values limits.

Table 3. The humus content modification (%) under the soil works influence, year 2016

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	3.40	3.62	3.50
The annual disk	4.00	3.72	3.59
Chisel plough annually	3.82	3.70	3.25
DL _{5%} (for A- soil works) = 0.06			
DL _{5%} (for B-depth) = 0.09			
DL _{5%} (for AXB) = 0.18			

*DL - the limit difference (variance analysis method)

Source: own research.

In the next 10 cm, the highest humus content, as a result of the applied technological works, was recorded in the variant where the plowing was used, the limits of the humus reached 3.4%, followed by the variant where the soil was worked with the disc each year with an average content of 3.22% and followed by the variant where the chisel was used (3.04%).

Soil reaction

The pH value is a dynamic measure and is affected by the seasonal variation of the hydrothermal regime.

The soil reaction class in which most of the studied variants fall is slightly alkaline, as are the native soil reactions values (Table 4 and 5).

Table 4. The pH values modification under the soil works influence, year 2014

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	7.18	7.44	7.37
The annual disk	7.30	7.31	7.35
Chisel plough annually	7.75	7.66	8.01
DL _{5%} (for A- soil works) = 0.02			
DL _{5%} (for B-depth) = 0.03			
DL _{5%} (for AXB) = 0.07			

*DL - the limit difference (variance analysis method)

Source: own research.

Only the classical soil tillage (plowing) causes a decrease in the soil's response at 0-10 cm

depth reaching values of 7.19 and 7.16 pH units, which puts the soil in the neutral reaction class, values sustained also by other researchers: [14], [7] and [1].

Determinations made on this non-cropped soil type show pH values ranging from 7.90 to 8.34 (low alkaline).

The large number of works carried out in this perimeter led to an improvement in the soil's reaction due to the reduction in the surface of the substances leached by the soil works in the vegetation period.

Soil reaction between years 2014 and 2016, in the first 10 cm, shows an average decrease of up to 7.19 in the case of plowing and 7.38 in the disk work, limits that fall into the neutral-low alkaline field.

Table 5. The pH values modification under the soil works influence, year 2016

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	7.20	7.48	7.62
The annual disk	7.47	7.61	7.85
Chisel plough annually	7.84	7.67	7.74
DL _{5%} (for A- soil works) = 0.04			
DL _{5%} (for B-depth) = 0.03			
DL _{5%} (for AXB) = 0.08			

*DL - the limit difference (variance analysis method)

Source: own research.

In all experimental variants, the soil reaction is maintained in the same low alkaline range (7.18 - 8.01) due to the high carbonates concentration which increases the pH and due to the climatic conditions with precipitations above the normal average of this region.

In the variant with the chisel work there is a pH decrease from 8.00 to 7.80 pH units, not very significant, due to the leaching of salts in the deeper layers. In this variant the pH maintains the limits of alkalinity.

The content of total nitrogen in soil

Regarding the nitrogen content of the soil, it is assumed that the arable layer of the cultivated soils in the temperate zone contains on average between 0.09-0.38% total nitrogen and is influenced by the climate, the type of vegetation, topography and parental rock [10] and [12].

Table 6. The total nitrogen content of the soil under the influence of soil work method (ppm), year 2014

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	0.265	0.202	0.196
Disk	0.298	0.222	0.172
Chisel plough annually	0.215	0.178	0.173
DL _{5%} (for A- soil works) = 0.01			
DL _{5%} (for B - depth) = 0.01			
DL _{5%} (for AXB) = 0.02			

*DL - the limit difference (variance analysis method)

Source: own research.

Table 7. The total nitrogen content of the soil under the influence of soil work method (ppm), year 2016

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	0.232	0.189	0.180
Disk	0.260	0.225	0.184
Chisel plough annually	0.215	0.186	0.170
DL _{5%} (for A - soil works) = 0,01			
DL _{5%} (for B - depth) = 0,01			
DL _{5%} (for AXB) = 0,02			

*DL - the limit difference (variance analysis method)

Source: own research.

The total nitrogen content of the soil following the application of various soil works methods, during the period 2014-2016, recorded the highest values after soil work with the disc (0.298%) and the chisel work caused an average drop of 0.035% in the first 10 cm compared with the conventional plowing, being also the variant with the lowest nitrogen content (Table 6 and 7).

The limit for the interpretation of nitrogen content is medium and it is found in all variants with works, only the variant with the disc records large values in the first 10 cm.

On a depth of 10 - 30 cm, during the period 2014-2016, the total nitrogen content is kept within the mid-range limits in all variants with soil works.

CONCLUSIONS

Due to the anthropic activity, especially of the technological works of the soil, the initial aspect of the natural framework can change beneficial or detrimental to the soil nutrient content. The proposed works have the role of

intensifying pedogenetic processes for the formation of fertile soil.

Soil works methods have little influence on the humus content, its modification being insignificant and keeping within medium range limits. The work of the soil with the disc harrow determines the highest accumulation of humus, at a depth of 10-20 cm, with average values of 3.50%. The highest humus content is found in the 0-10 cm layer due to an accumulation of organic matter not introduced on the soil depth.

The soil reaction, has passed from the neutral field to the field taken in the crop and ploughed annually by returning the furrow to the native soil where the pH had slightly alkaline values (7.90) under the influence of the soil works. Variants with disk and chisel do not modify significantly the soil's pH, but fall within the lower limit of the low- alkaline interval.

The total nitrogen content in the soil was lower in the variants with plowing and disk works, and the variant worked with the chisel determined the best mineralization of the nitrogen. The difference between the variants in terms of total nitrogen content is generated by the distribution of organic matter on the soil profile and the microbiological activity in the soil and decreases on the depth of the arable layer.

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