DYNAMIC OF SOME PHYSICAL AND CHEMICAL PROPERTIES OF A CAMBIUM CHERNOZEUM FROM VINGA PLAIN IN CONSERVATIVE AND CONVENTIONAL TILLAGE OF SOIL

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Abstract: *The research made is falling on the line to develop an sustainable agricultural system, responding to local requirements for establishing a scientific database necessary for the development of technology and measures of agroecosystems integrated management. The passing to no-till cultivation system radically changes the content of technological elements, that simplifies the technology by the suppression of soil work, so the impact on the agricultural ecosystem is different from that of conventional technology, first decreases the pressure on agricultural ecosystem and on the other apear new interactions, new disrupt the new balance or imbalances. The research made in the world concerning no-till technology get some information about the implications of this system of agricultural cultivation on the environment, showed that the impact varies from one area to another, depending on climatic and soil conditions encountered, agricultural management. The researches regarding the evolution of the agro-ecosystems quality and productivity from the Vinga High Plain in the no-till crop system tries to highlight the quality and quantity changes emerged in the agricultural ecosystem. There are presented some aspects regarding the physical-geographical characterization necessary for the experimental field localization are presented. Here are briefly introduced the geology and lithology of surface materials, clime conditions, land drainage etc., as defining elements for edaphic resources' main characteristics. Also, regarding the soil conditions have been determined the defining characteristics for the ecosystems productivity, granulated structure and humus content. In close relation with the first two aspects have been established the water content and the cationic change capacity.. In order to determine the complex relation that take place between different soil characteristics and agro-ecosystems components, the researches were conducted both on field and laboratory.*

Key word: *propertie, plain, conservative, conventional, tillage*

INTRODUCTION

Appeared in the Mesolithic Era as a way of producing the needs for everyday life by cultivating plants and husbandry, agriculture became at the same time with the evolution of humans and society a branch of the material production, which involves all the works and methods used for obtaining alimentary products and some prime matters by using the soil in this purpose (ȚĂRĂU D., and all., 2008).

The conventional tillage system, generalized for crop cultivation in our country, includes a large number of works designed to make conditions more favorable for crop sowing and plant development.

This agriculture system disrupt, often very serious, the balance in agricultural ecosystems, produce crops pollution, soil pollution and groundwater or surface water pollution and is very often too expensive in comparison with the financial possibilities of the farmers.

Unconventional tillage system, thought the idea of optimal in terms of technological, economic and environmental, for certain area, unit or parcel, is the basis of the cultivation technologies of alternative and sustainable agriculture (DUMITRU ELISABETA and all., 1990).

Sustainable development, characterized by productivity, profitability, environmental friendliness and ability to conserve resources, involves the development of tillage systems through proper energy management, combined with increasing diversity of agroecosystems and environmental management in plant protection (BORZA I. and all, 2002).

The no-till technology belongs to the agricultural systems that have the role to conserve the soil, being known in the modern agriculture from the 1950s when on the American continent were settled up the technologies with minimum works in order to find some practical methods for reducing and stopping the soil erosion, a phenomenon that was more and more aggressive on the fields cultivated as an conventional system (MONICA ANDRU, 2004).

The researches regarding the evolution of the agro-ecosystems' quality and productivity from the Vinga High Plain in the no-till crop system tries to highlight the quality and quantity changes emerged in the agricultural ecosystem. The no-till crop system was applied at the wheat, maize and soybean crops.

The passing to no-till system change the structure of technological elements, through less soil works, so the impact on agro-system is different comparing with conventional tillage, first lessing the intervention pressure on agro-system ant secondly appears new interactions, new equilibriums and disequilibriums.

MATERIAL AND METHODS

The experimental field is placed on a cambic cernosiom, with a medium content of clay, dominant in the Prodagro West Arad agro-centre and representative for a large surface in the Banat-Crisana Plain, the experiment being situated at approximately 500 m SW from the Andagra farm, located on the Arad cadastral territory, coordinates $46^0$7'55" N latitude and $21^0$17'45" E longitude, 115 m altitude.

The experiment has three factors, being of the type 2x2x3, with subdivided parcels into 4 repetitions (144 parcels). The surface of one plot is of 27 sm (3x9), the total surface of the experiment being of 3888 sm.

The experimental factors are: Factor A – the technological system (A1 – without deep soil working, A2 – with deep soil working), Factor B- the culture system (B1- classic culture system, B2- No-till culture system), Factor C- fertilizers doses (C1- N_0 P_0 K_0, C2- N_{80} P_{80} K_{80}, C3- N_{160} P_{80} K_{80}).

The research of the ecopedologic conditions was made according to "The methodology of elaborating of pedological studies", vol. I, II and III elaborated by the ICPA Bucharest in 1987, completed with specific elements from the Romanian System of Taxonomy of Soils (SRSTS-2003).

To determine physical and chemical properties of cambium chernozem from Aradul Nou more samples were collected in both natural settlement (to determine the apparent density) and a settlement disturbed (to determine other properties).

Preparation, analysis of probes and interpretation of results was done in OSPA Timis and USAMVB Timisoara labs.

RESULTS AND DISCUSSIONS

Vinga high plain is the oldest and the most complex among Banat-Crisana plains and extends south of Mures everglade, west of Lipova hills, north of Bega low plain, east of Galatca plain. It is formed at the convergence of hills glacisist, shaped by a net of flowing waters and erosion valleys (ȚĂRĂU D., and all., 2008).

From the geo-morphological point of view the perimeter on which are located the experiments belongs to the large physical –geographic unity called the Vinga High Plain.

Relief present itself as a succession of high plain , almost even, with altitudes between 95-200 m , separated by wide valleys, rather deep, collected quite in exclusivity by Berecsau river (and less by Mures river).

The zone between the rivers are well individuated in 5 steps layed in fan shape:Seceani (180 m), Alios (160 m), Vinga (150 m), Calacea (130 m), Satchinez (100 m) realized by Mures river at different geological moments an partly tectonically influenced.

The overall look is the piedmont plain which descends to the northwest by step (which originated with the withdrawal of the Pannonian lake) with the line passes several times without overheads terrace (which is characteristic in connection with the Mures meadow and Aranca plain) (ȚĂRĂU D., and all., 2003).

Hydrographically, the perimeter where the experiment is placed belongs to the hydrographic basin of Mures river which flows at about 2-3 km north from this. The pedo-phreatic levels are at 5,1 – 10 m depth (they don't interfere in the pedo-genesis processes) in flat areas and between 1,5 – 3,0 m depth in the valleys.

The climate is a temperate-continental one with Mediterranean influences, the medium multi-annual temperature being of 10,4 ^{0}C and the multi-annual rainfall 593,5 mm .

As a result of the cosmic-atmospheric and telluric factors intervention, under a vegetation specific to the forest steppe, in the zone were created cambium cherrnozems, specific to the researched perimeter.

Soil's texture, a very stable physical feature, is medium clay on the whole profile. The Apparent Density (DA) has medium values in the worked layer from the classic system, high in the first 10 cm in no-till system and very high in the middling third of the soil profile in the two systems (table 1).

Table 1

Phisical properties of cambium chernozeum
from Aradul Nou

Horizonts	UM	Ap	Atp	Am	A/B	Bv	B/C	Cca	Ck	Ck	Ck
Deepness	cm	21	33	45	59	80	96	125	155	175	200
Coarse sand (2.0 – 0.2 mm)	%	0.8	0.7	0.4	0.2	0.3	0.2	0.2	0.5	0.8	0.7
Fine sand (0.2 – 0.02)	%	30.3	26.9	29.2	37.4	32.8	29.9	28.1	31.4	31.4	27.6
Silt (I + II) (0.02-0.002 mm)	%	29.5	33.5	28.0	23.5	27.5	29.5	34.1	25.8	24.9	29.8
Coloidal clay (sub 0.002)	%	39.4	38.9	42.4	38.9	39.4	40.4	37.5	42.3	42.9	42.0
Phisical clay (praf II +arg col)	%	52.4	52.9	56.9	49.9	53.9	51.4	55.1	55.7	54.8	55.9
TEXTURE		TT	TT	TT	TT	TT	TT	TT	TT	TT	TT
Specific Density (Ds)	g/cm^3	2.63	2.63	2.65	2.64	2.66	2.65	2.65			
Aparent density (Da)	g/cm^3	1.48	1.48	1.42	1.44	1.46	1.48	1.34			
Total phorosity (Pt)	%	43.7	43.7	46.7	45.5	45.1	44.2	49.4			
Aeration phorosity (Pa)	%	5.0	5.1	8.9	7.9	7.0	5.3	14.6			
Higroscopical coefficient(CH)	%	9.2	9.1	9.9	9.1	9.2	9.5	8.8			
Fadind coefficient (CO)	%	13.8	13.7	14.9	13.7	13.8	14.2	13.2			
Field capacity (CC)	%	26.1	26.1	26.4	26.1	26.1	26.2	26.0			
Total capacity (CT)	%	29.5	29.5	32.7	31.6	30.9	29.8	36.9			
Utile water capacity (CU)	%	12.3	12.4	11.5	12.4	12.3	12.0	12.8			

We can notice an increase in apparent density values, both in the range 0-10 cm and 10-20 cm range, in the classical system leading from 1.36 - 1.38 to the 1.50 - 1.58 and in no-tillage system from 1.53 - 1.57 from 1.62 - 1.73, both variants and in the variants without deep work of soil. And for the other intervals is similar upward trend (table 2).

Table 2

Values of apparent density (Da) on a cambium chernozem from Aradul Nou

Technological system		Culture	Depth(cm)									
			3-8		15-20		40-45		60-65		80-85	
			2007	2010	2007	2010	2007	2010	2007	2010	2007	2010
Without deep work of soil	No-tillage	Maize	1,57	1,51	1,60	1,77	1,61	1,55	1,61	1,65	1,59	1,68
		Soybean	1,56	1,62	1,56	1,63	1,58	1,63	1,57	1,64	1,55	1,70
		Wheat	1,53	1,73	1,53	1,71	1,63	1,60	1,52	1,61	1,50	1,75
	Classic	Wheat	1,38	1,57	1,57	1,76	1,59	1,60	1,58	1,67	1,59	1,67
		Soybean	1,39	1,57	1,54	1,75	1,59	1,65	1,52	1,60	1,58	1,66
		Maize	1,36	1,56	1,54	1,59	1,60	1,58	1,53	1,66	1,56	1,67
With deep work of soil	No-tillage	Maize	1,57	1,66	1,60	1,73	1,61	1,59	1,61	1,65	1,59	1,59
		Soybean	1,56	1,66	1,56	1,51	1,58	1,63	1,57	1,65	1,55	1,68
		Wheat	1,53	1,53	1,53	1,61	1,63	1,60	1,52	1,62	1,50	1,64
	Classic	Wheat	1,38	1,59	1,57	1,72	1,59	1,53	1,58	1,68	1,59	1,55
		Soybean	1,39	1,50	1,54	1,73	1,59	1,68	1,52	1,74	1,58	1,68
		Maize	1,36	1,58	1,54	1,62	1,60	1,63	1,53	1,64	1,56	1,58

The Total Porosity (PT) has low values in the 0 – 33 cm interval, and also in the 45 – 96 cm one. The aeration porosity, which represents all the pores occupied with air when the soil is in optimum humidity conditions, has very low values, excepting the worked layer from the classic system, where it has low values and the first 10 cm depth in No-till system where the values are very low.

The highest values of total porosity (table 3), the range of 0-10 cm were recorded in the classical system, with values ranging from 40.3 to 40.68% in the variants without deep work and 39.54 to 42.97% in the variants with deep work of soil, compared with no-tillage system, where there were slightly smaller values (34.22 to 38.40% in the variants without deep work and from 36.88 to 41.82% in variants with deep work).

Table 3

Values of total porosity (PT) on a cambium chernozem from Aradul Nou

Technological system		Culture	Depth(cm)									
			3-8		15-20		40-45		60-65		80-85	
			2007	2010	2007	2010	2007	2010	2007	2010	2007	2010
Without deep work of soil	No-tillage	Maize	40,30	42,59	39,16	32,70	39,25	41,51	39,02	37,50	40,23	36,84
		Soybean	40,68	38,40	40,68	38,02	40,38	38,49	40,53	37,88	41,73	36,09
		Wheat	41,83	34,22	41,83	34,98	38,49	39,62	42,42	39,02	43,61	34,21
	Classic	Wheat	47,53	40,30	40,30	33,08	40,00	39,62	40,15	36,74	40,23	37,22
		Soybean	47,15	40,30	41,44	33,46	40,00	37,74	42,42	39,39	40,60	37,59
		Maize	48,29	40,68	41,44	39,54	39,62	40,37	42,05	37,12	41,35	37,22
With deep work of soil	No-tillage	Maize	40,30	36,88	39,16	34,22	39,25	40,00	39,02	37,50	40,23	40,23
		Soybean	40,68	36,88	40,68	42,59	40,38	38,49	40,53	37,50	41,73	36,84
		Wheat	41,83	41,82	41,83	38,78	38,49	39,62	42,42	38,64	43,61	38,35
	Classic	Wheat	47,53	39,54	40,30	34,60	40,00	42,26	40,15	36,36	40,23	41,73
		Soybean	47,15	42,97	41,44	34,22	40,00	36,60	42,42	34,09	40,60	38,34
		Maize	48,29	39,92	41,44	38,40	39,62	38,49	42,05	37,88	41,35	40,60

In variants planted with soybeans in no-till system were higher values on the horizon 10-20 cm. For other intervals, total porosity values presented are much more uniform in both classical and no-tillage system, with and without deep work of soil.

About the chemical properties of the cambium chernozem from Aradul Nou, we can made the following remarks:

The analyzed soil has an acid reaction (5,9 – 6,8) in the first 80 cm of the soil profile, neutral between 80- 125 cm and low alkaline between 125 – 200 cm depth.

The mobile phosphorus content (P) in the worked soil (Ap) has medium values (35,0 ppm) at the limit of alert threshold (concerning the nutrition lack) the mobile potassium supply (K) having medium values (153 ppm), values which are lower on with the profile (table 4).

The humus reserve in the first 50 cm is high, and the natrium index (I.N.) has medium values in the worked layer (Ap) and also in the 0 – 45 cm layer.

Table 4

Chemical properties of cambium chernozeum from Aradul Nou

Horizonts	UM	Ap	Atp	Am	A/B	Bv	B/C	Cca	Ck	Ck	Ck
Deepness	cm	21	33	45	59	80	96	125	155	175	200
pH in water		5.95	6.10	6.20	6.55	6.70	7.10	7.70	8.20	8.25	8.15
Carbonates ($CaCO_3$)	%							12.10	6.85	3.55	2.60
Humus	%	3.40	2.10	2.10	1.70	1.60	1.25	1.20	1.00	0.90	0.70
Nitrogen index (IN)		3.06	1.91	1.95							
Humus reserve (50 cm)	to/ha	191.0									
P mobile	ppm	35.0	23.0	5.0	4.0	4.0	7.0	11.0	7.0	5.0	4.0
K mobile	ppm	153	128	128	123	113	136	113	98	113	113
Exchanging bases (SB)	me/100	35.6	31.2	26.8							
Exchange H (SH)	me/100	12.0	10.0	7.9							
Saturation in base degree (V)	%	90	91	93							
Mobile aluminium	me/100	0.10	0.05	0.05							

One can notice a decrease in pH values from the weak acid values to strong acid values. In terms of nitrogen content it is found between the same limits of interpretation as in 2007. Phosphorus and potassium content can be seen a small increase in the content of these elements, but still surrounding the same limits of interpretation (table 5).

Table 5

Evolution of the main agrochemical properties of the cambium chernozem from Aradul Nou

Technological system		Culture	pH		IN (ppm)		P (ppm)		K (ppm)	
			2007	2010	2007	2010	2007	2010	2007	2010
Without deep work of soil	No-tillage	Maize	6,18	5,25	2,50	2,41	40	70,0	250	184,7
		Soybean	6,20	5,86	2,60	2,88	38	26,0	260	295,6
		Wheat	6,22	5,72	2,45	2,92	65	86,0	260	324,8
	Classic	Wheat	6,26	5,67	2,20	2,46	33	70,0	260	205,7
		Soybean	5,95	5,58	2,10	2,49	40	53,0	230	248,9
		Maize	5,85	5,52	2,40	2,20	47	33,0	270	203,7
With deep work of soil	No-tillage	Maize	6,18	5,59	2,50	2,76	40	23,0	250	285,1
		Soybean	6,20	5,74	2,60	3,24	38	62,0	260	197,6
		Wheat	6,22	5,78	2,45	2,49	65	19,0	260	232,7
	Classic	Wheat	6,26	5,89	2,20	3,08	33	32,0	260	203,4
		Soybean	5,95	5,92	2,10	2,56	40	19,2	230	221,3
		Maize	5,85	5,95	2,40	2,28	47	32,6	270	214,7

CONCLUSIONS

Cultivating the agricultural fields by using incomplete and incoherent technologies seriously damages both quantitatively and qualitatively not only the production but especially the soil resources, the practice proving that in order to function the little or large agricultural cultivation, the main condition is the choice of the most suitable technologies.

The obtained production results can fundament in the future the choissing of some adequate technologies for the climatic and soils conditions of the area where the research was made and also for other similar areas.

In terms of crop suitability to no-till system, soil texture has some restrictions due to clay - clay and secondary compaction, without excluding the possibility of adopting no-till practices.

The research supports the ability to promote no-till technology in production established itself selective implementation, where conditions are suitable ecopedological this system of agriculture, under effective management.

BIBLIOGRAPHY

1. ANDRU MONICA, 2004- Influența tehnologiei No-till asupra evoluției bolilor şi dăunătorilor în culturile de grâu si porumb. Teză de doctorat, USAMVB Timişoara pag 221
2. BORZA I., ȚĂRĂU D., ȚĂRĂU IRINA ,2002, Limitation Factors and terrain yeild including measures in Vinga high plain, Scientifical Papers, Faculty of Agriculture , XXXXIV, Ed. Oriy. Univ. Pg. 69-76
3. CANARACHE A, ELISABETA DUMITRU, 1991. Criterii pedologice de evaluare a sistemelor de lucrări minime de soluri. Ed. Acad., Univ. Athenaeum, Cluj-Napoca.
4. DICU D., BORZA I., ȚĂRAU D.. 2009, Dynamics of some components from agro-system in conservation and conventional tillage of soil, Research Journal of Agricultural Sciences, Facultatea de Agricultură, Vol. 41 (2) Timişoara, Ed. Agroprint. ISSN 2006-1843
5. GUŞ P., A. PUSCU, 1999. Cercetări privind impactul sistemului de lucrare asupra porozității şi structurii solului. Simp. Int. 21-22 Oct., Cluj-Napoca.
6. DUMITRU ELISABETA, GUS P., ENACHE ROXANA, DUMITRU M, 1990- Efecte permanente a unor practici agricole asupra stării fizice a solului., Ed. Risoprint, Cluj pag 203
7. ȚĂRĂU D., BORZA I., , BĂGHINĂ N., DICU D., IORDACHE MĂDĂLINA, 2008, Dinamics of some phisico-chemical and hydrophisical characteristics of a cambic chernozeum from Vinga plain, in No-till cultivation system, Lucrări ştiințifice USAMVB, Seria A, Vol. LI, Bucuresti, ISSN 1222-5339
8. ȚĂRĂU D, BORZA I, ȚĂRĂU IRINA, VLAD H, DOLOGA D, JURCUȚ T, 2003- Mediul natural, cadru structural si funcțional în definirea factorilor edafici în vestul României. Ştiința Solului, vol XXXVIII, Ed. Sigmata Timişoara, pag 137-161