

# Soil main Physical and Chemical Characteristics Modification as Influenced by Conventional and Conservative Soil Works Technologies in Areas Subject to Aridification

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## Introduction

Agriculture enhancement led to food production substantial increase in the last century. But intensive agriculture can have negative effects upon environment as regards biodiversity, it determines greenhouse gas emissions increase, erosion, and soil degradation. Once degraded soil recovery is an extremely slow process. According to Food and Agriculture Organization of the United Nations (FAO) 33% of World soils are moderately up to very degraded which endangers food production and food security. This threat can be counterpoised by implementing soil management sustainable practices.

In Romania 11,298,069.03 ha are susceptible of degradation through aridification and possible desertification, out of which 7,546,349.87 ha (66.8%) present high susceptibility, and 2,970,082.19 ha (26.3%) moderate susceptibility.

Both soil and terrains degradation and aridification phenomenon manifests and possible desertification occurrence in some areas of Romania are closely linked to environment conditions and natural resources unsuitable management: vegetation, climate, soil, and water. Soil and terrains degradation has mostly anthropic causes, while in the case of aridity, drought, and desertification the climate factor is predominant.

Measures to diminish global warming are required to preserve and increase soil carbon supply such as technologies with minimum or without soil works.

The present research aims to identify causes that generate terrains degradation processes, assess conservative agriculture technologies pertinence and their implementation in order to establish appropriate agrotechnical methods for soil conservation in agroecosystems affected by aridification.

## Material and Methods

Two systems of soil works were experimented: conventional (classical) and conservative (minimum tillage) located at Brebeni, Olt County; Adunații Copăceni, Giurgiu County; Constantin Brâncoveanu, Călărași County; Roșiori, Brăila County.

Soil samples were collected by the 5-10; 25-30; and 45-50 cm depths. Chemical analyses and determinations were carried out complying with the Working Methodology of ICPA Bucharest (MESP, vol. I-III, 1987).

For the soil physical characterization texture was determined, bulk density (Daw, g/cm<sup>3</sup>), total porosity (TP, %v/v), shrinkage index (IC), aeration porosity (AP, %v/v), saturated hydraulic conductivity (Ksat, mm/h), and standard penetration resistance (RD).

## Results and Discussions

### Brebeni, Olt County, area pedological and climatic characterisation

Most of the territory belongs to the Iminog Plain, Boian Plain sub-unit. Micro depressions and dells fragmenting the cliffs are to be met as micro relief forms. Multi annual average temperature is 10-11°C (annual average) and varies from -1.7°C (monthly average) in January, the coldest month of the year, to 22.1°C in July, the hottest one. Rainfall annual average amounts to 519 mm, the poorest month is February (25.6 mm) and the rainiest is June (99.5 mm). The Brebeni Commune territory belongs to the transition zone from forest steppe to forest (oak level). Woody species occur such as *Quercus robur*, *Quercus cerris*, *Quercus frainetto*, *Prunus spinosa*, *Tilia sp.*, *Acer campestre*, *Fraxinus excelsior*. In the meadow area *Populus alba*, *Alnus glutinosa*, *Salix fragilis* occur. Of the herbaceous species *Setaria viridis*, *Cynodon dactylon*, *Convolvulus arvensis*, *Polygonum aviculare* can be mentioned. The representative soil type of the body is Haplic Luvisol (WRB-SR 2014) (Figure 1) with a medium clay loam – loamy clay structure.



Figure 1. Brebeni, Olt County, geographic coordinates: N 44.40928; long: E 024.48699; main profile in minimum tillage system and agrophysical profile in conventional system

### Adunații Copăceni, Giurgiu County, area pedological and climatic characterization

From the geo-morphological point of view the body is part of the Romanian Plain. From the relief point of view its main characteristic is typical smooth plain. The climate is temperate continental. Average temperatures of the summer months have values between 20.4 and 23.2°C and the maximum ones reach 38.7°C. Winters are cold as influenced by the east continental and arctic cold air masses, with many frosty days. Monthly average temperatures range from +0.3 to -3.2°C and those of the monthly average minimums between -1.5 and -16.4°C. There are long drought durations due to low rainfall in summer months, when evapotranspiration manifests itself, which determines a significant humidity deficiency sometimes strongly felt by cultivated plants. Vegetation belongs to forest steppe consisting of oak forests and herbaceous vegetation. The representative soil type is Haplic Luvisol (WRB-SR 2014) (Figure 2) with a medium loam – medium clay loam texture.



Figure 2. Adunații Copăceni, Giurgiu County, geographic coordinates: N 44.21631; long: E 026.07752; main profile in minimum tillage system and agrophysical profile in conventional system

### Constantin Brâncoveanu, Călărași County, area pedological and climatic characterization

The studied area belongs to the Romanian Plain, Bărăganul Ialomiței sub-unit. The climate is moderately continental. Annual average temperature is 10.7°C. The hottest months are July with 22.2°C and August with 21.9°C. The month with the lowest temperature is January: -22°C, followed by February. Maximum 40.9°C and minimum 20.6°C temperatures show the climate specific continental character. Annual rainfall average is 552.4 mm. The vegetation mostly belongs to the steppe area once characterized by grasslands consisting of: *Poa bulbosa*, *Stipa capillata*, *Artemisia austriaca*, *Euphorbia stepposa*, *Festuca valesiaca*. The representative soil type is Haplic Chernozem (WRB-SR 2014) (Figure 3) with a medium loam texture.



Figure 3. Constantin Brâncoveanu, Călărași County, geographic coordinates: N 44.49972; long: E 027.40214; main profile in minimum tillage system and agrophysical profile in conventional system

### Roșiori, Brăila County, area pedological and climatic characterisation

The territory belongs to the Middle Bărăgan sub-unit. The climate is moderately continental with more temperate keys in the Siret Meadow. Yearly rainfall are low, 450 l/m<sup>2</sup> on an average. The plain belongs to the subarid zone in which steppe grasslands dominate with *Festuca valesiaca*, *Stipa capillata*, *Dilpachne serotina*, *Artemisia austriaca*, *Agropyron cristatum* associations. On strongly salinized areas halophile plants frequently occur such as: *Suaeda maritima*, *Salicornia herbacea*, *Salsoda soda* *Bassia sp.* The unit's representative soil type is Haplic Chernozem (WRB-SR 2014) (Figure 4) with a sandy silt loam – sandy silt texture.



Figure 4. Roșiori, Brăila County, geographic coordinates: N 44.84115; long: E 027.383945; main profile in minimum tillage system and agrophysical profile in conventional system

Table 1. Physical properties of the studied soil profiles

Localization	Soil works system	Depth cm	wi	Dawi	RP	IC	ksat	PTwi
			(%g/g)	(g/cm <sup>3</sup> )	(Kg/cm <sup>2</sup> )	(-)	(mm/h)	(%v/v)
Brebeni	Classic	5-10	22.7	1.30	49	0.0079	42.25	50.9
		20-25	22.8	1.43	83	0.0076	3.81	46.2
		45-50	29.0	1.34	51	0.0082	0.34	49.3
	Conservative	5-10	26.2	1.03	17	0.0118	103.57	61.0
		20-25	25.2	1.46	88	0.0106	0.34	45.0
		45-50	31.7	1.31	44	0.0105	0.11	50.7
Adunații Copăceni	Classic	5-10	10.7	1.26	21	0.0129	33.43	52.6
		20-25	13.0	1.41	49	0.0090	6.13	46.7
		45-50	18.8	1.48	76	0.0105	6.23	44.3
	Conservative	5-10	11.7	1.26	26	0.0151	28.27	52.5
		20-25	12.7	1.37	42	0.0167	3.12	48.2
		45-50	17.5	1.57	82	0.0027	0.11	40.9
Constantin Brâncoveanu	Classic	5-10	14.3	1.22	20	0.0089	36.46	54.0
		20-25	12.8	1.16	21	0.0162	54.59	56.2
		45-50	19.1	1.33	53	0.0066	13.81	49.7
	Conservative	5-10	12.3	1.09	15	0.0173	74.82	58.9
		20-25	15.9	1.46	63	0.0041	2.64	44.8
		45-50	17.5	1.35	43	0.0052	10.96	48.9
Roșiori	Classic	5-10	19.0	1.04	7	0.0093	92.21	60.6
		20-25	21.0	1.11	13	0.0082	87.82	58.1
		45-50	22.5	1.15	23	0.0046	55.00	56.5
	Conservative	5-10	15.1	1.29	32	0.0166	17.35	51.3
		20-25	16.7	1.32	32	0.0100	17.12	50.1
		45-50	17.4	1.16	19	0.0032	43.80	56.3

Table 2. Chemical properties of the studied soil profiles

Localization	Soil works system	Depth cm	pH	Humus		P <sub>av</sub> <sup>1</sup>	K <sub>av</sub>
				%	Nt		
Brebeni	Classic	5-10	6.01	2.98	0.121	61	148
		25-30	5.65	2.32	0.096	26	125
		45-50	5.43	1.73	0.080	8.8	113
	Conservative	5-10	5.08	3.81	0.160	31	203
		25-30	5.56	2.21	0.124	12	141
		45-50	6.17	1.79	0.091	4.2	109
Adunații Copăceni	Classic	5-10	5.68	2.68	0.119	50	168
		25-30	5.88	2.44	0.109	55	162
		45-50	6.46	1.73	0.084	18	175
	Conservative	5-10	5.75	2.62	0.124	55	162
		25-30	5.78	2.21	0.112	45	156
		45-50	6.48	1.61	0.085	21	185
Constantin Brâncoveanu	Classic	5-10	6.23	2.98	0.145	16	253
		25-30	6.21	2.68	0.144	22	208
		45-50	6.71	2.21	0.110	13	206
	Conservative	5-10	6.07	3.40	0.103	21	232
		25-30	5.99	2.74	0.133	18	189
		45-50	6.52	2.32	0.114	11	195
Roșiori	Classic	5-10	7.90	3.61	0.182	56	232
		25-30	8.17	2.25	0.117	6.9	133
		45-50	8.24	2.01	0.101	5.2	117
	Conservative	5-10	8.03	2.90	0.050	17	156
		25-30	8.03	2.78	0.141	11	174
		45-50	8.22	1.95	0.108	10	95

## Conclusions

Soil condition in the brief 2023-2024 agricultural year experimentation duration, in extreme drought circumstances in the studied areas, was less influenced by the soil works systems (conventional and conservative). Conservative technology with all works done in one passage can be considered as a bettering technology for preventing soil degradation by compaction, deformation, and waterlogging. Future research aims at continuously monitoring the studied soils in order to ascertain the differences induced by conservative technologies for the better.