THE PEDOGEOCHEMICAL SEGREGATION A FEW HORIZONS IN SOILS FROM GLASS HOUSES

SEGREGAREA PEDOGEOCHIMICĂ A UNOR ORIZONTURI ÎN SOLURILE DIN SERE

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Abstract. *Particular for soils from glasshouses are the intense changes of of mineralogy and chemistry, salinization processes, formation at of a compact and impenetrable horizon (Ahok horizon). In function of exploitation conditions and by the chemical-mineralogical characteristics of soils from glasshouses, the Ahok horizons can have frangipane properties, expressed more or less. These horizons determined a geochemical segregation of soils from glasshouses: (**i**) superior horizons, above Ahok(x) horizon evolve in weak oxidative conditions, weak alkaline pH, higher salinity, humidity and temperature; (**ii**) inferior horizons, below Ahok(x) horizon evolve in weak reducing conditions weak acid pH, lower salinity, humidity and temperature. Concomitant with the development of Ahok(x) horizons, the rapid degradation of the properties of soils from glasshouses is observed.*

Key words: greenhouse, soil, segregation horizon

Rezumat. *Specifice pentru solurile din sere sunt variabilitatea mineralogiei şi chimismului, procesele de salinizare a orizonturilor superioare, formarea unui orizont compact şi impermeabil (orizontul Ahok). În funcţie de condiţiile de exploatare şi de caracteristicile chimico-mineralogice ale solurilor orizonturile Ahok pot prezenta însuşiri fragipanice mai mult sau mai puţin exprimate. Aceste orizonturi determină o segregare pedogeochimică a solurilor din sere: (**i**) orizonturile superioare, situate deasupra orizontului Ahok(x), evoluează în condiţii slab oxidante, pH slab alcalin, salinitate, umiditate şi temperatură mai ridicate; (**ii**) orizonturile inferioare, situate sub orizontul Ahok(x), evoluează în condiţii slab reducătoare, pH slab acid, salinitate, umiditate şi temperatură mai reduse. Concomitent cu dezvoltarea orizonturilor Ahok(x) se degradează rapid proprietăţilor agrochimice ale solurilor din sere.*

Cuvinte cheie: seră, sol, segregare orizont

INTRODUCTION

The soils from glasshouses are characterized by a very large variability of mineralogy and chemistry, which are traduced by intense modifications of superior horizons. in many cases there are conditions for the apparition of new pedogenetic horizons through "new-pedogenesis" processes (A. Conea & T. Postolache, 1976; C.V. Secu & C.V, Patriche. 2007). Under these conditions. the definition of some general characteristics of soils from glasshouses is very difficult. Practically, each type of soil from this category having distinct pedological and chemical-mineralogical characteristics, mostly determined by the nature of parental material and by the exploitation technologies (V. Voican & V. Lăcătuş, 1989; A. Canarache, 1995; F. Filipov et al., 2004; 2008). Concerning to the pedo-geochemistry of soils from glasshouses have not yet been written summary studies, most existing papers from literature are in fact, case studies of particular situations. The deficit of information from this field, together with the ambiguity of pedogenetical characters of diagnostic, makes difficult the unitary characterization of soils from glasshouses.

The utilization of intensive cultivation technologies of vegetables in glasshouses determined the degradation of morphological, physical and chemical characteristics of soils, by rapid evolution of salted processes (salinization and / or solidization), compaction, carbonatation, eluviation-illuviation, frangipane formation, stagnogleization, gleization etc. (A. Canarache, 1995; F. Filipov et al., 2004, 2008). Under these conditions, at depth of 30-40 cm is formed a compact and impenetrable horizon with frangipane characteristics, expresses more or less. The aspects about the formation of frangipane horizon in soils from glasshouses are not yet sufficiently know (N.E. Smeck et al., 1989; M.M. Duncan & D.P. Franzmeier, 1999; B.N. Weisenborn & R.J. Schaetzl, 2005). Whatever of the formation processes, the frangipane horizons determined a sever segregation in pedo-geochemical evolution of soils from glasshouses, with very important consequences on the agrochemical quality of these soils (V. Voican & V. Lăcătuş, 1989; F. Filipov et al., 2004, 2008).

Our studies have focused the apparition and manifestation conditions of pedo-geochemical segregation phenomena in case of soils from Copou – Iaşi glasshouse, and the effects of this on the pedo-geochemical and agrochemical characteristics of soils from glasshouses cultivated with vegetables. The results obtained by as have shown that together by mobile forms of Si, Al and Fe, at the formation of segregation horizons (frangipane), an important role has the phosphorus (organic. in special) and the organic-mineral complexes, respectively. The segregation effects are manifested in the differential dynamics of pedo-geochemical processes from superior horizons (situated above the segregation horizon), in comparison with the inferior horizons (situated below the segregation horizon), and in global evolution of degradation processes of soils from glasshouses.

MATERIAL AND METHOD

The experiments have been performed using soil samples from Copou-Iaşi glasshouse (IS.1 and IS.2 profiles – tables 1 and 2) and have follows the variations on profile of the physicochemical properties (absolute density, pH, redox potential) and of the grain-size and chemical-mineralogical compositions. The data concerning the distribution tendencies on profiles and the correlations between mineral and organic components of studied soils were combined with results of microscopic, spectral and X-ray diffraction studies, obtained for the occurrence forms of mineral and organic components in horizons of studied soil profiles. The pedological and physic-chemical analyses were done according with the methodology described by Z. Borlan and C. Răuţă (1981), and N. Florea et al. (1986), respectively.

RESULTS AND DISCUSSIONS

Our studies have evidenced the presence in Copou-Iaşi glasshouse, at a depth of 20-40 cm of a compact horizon, with reduced permeability and high hydrophobicity, which induced a strong discontinuity in water circulation in soil profile and a sever segregation in the dynamics of pedo-geochemical processes. This fact has been evidenced by contrasting physicochemical conditions and atypical evolutions of organic matter, distribution and speciation processes of microelements in superior horizons (situated above segregation horizon), in comparison with inferior horizon (situated below segregation horizon) – figure 1. The morphological. structural. mineralogical and chemical characteristics indicate that this horizon has relatively good expresses frangipane properties.

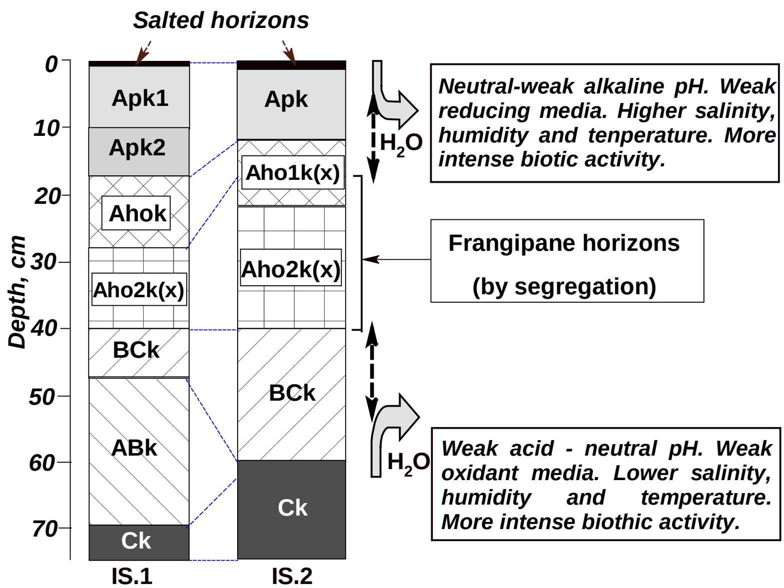

Fig. 1. Schematic representation of pedo-geochemical segregation phenomena of soils from Copou-Iaşi glasshouse.

The experimental results presented in tables 1 and 2. indicate a strong accumulation tendency, at the level of Aho1k and Aho2k(x) horizons, of fin grain-size fractions and of amorphous forms of mineral components. Also, was observed that in the composition of soil aggregates from frangipane horizon, and important weight have the smectites, amorphous iron oxides and oxy-hydroxides, amorphous silica and organic matter. The particularity of pedo-geochemical segregation horizon (frangipane) from Copou-Iaşi glasshouse is given by the relatively high contents of: (**i**) phosphorus – organic, in special, as inositol-phosphoric esters; (**ii**) fulvic acids; (**iii**) organic-mineral complexes – with special composition and structure (D. Bulgariu et al., 2008).

Table 1

Grain-size composition of soils and physical properties from Copou-Iaşi glasshouse (IS.1 and IS.2 profiles)

Horizons	H, cm	MG %	Sand			Dust			Clay			ρ; g/cm^3	pH		Eh; mV
			Ng	Nf	Total	Pg	Pf	Total	Ag	Af	Total		H_2O	KCl	
Profile IS.1: Hipohortic Entianthrosol Mixed-Proxicalcaric															
Ap1sck	0–10	3.68	6.15	38.94	45.09	10.35	8.40	18.75	17.91	12.28	30.19	2.62	7.91	6.36	508.13
Ap2sck	10–18	2.91	4.83	37.82	42.65	8.76	11.77	20.53	15.35	16.41	31.76	2.57	8.28	7.12	465.56
Aho1sck	18–28	2.05	1.57	35.95	37.52	5.33	16.27	21.60	10.36	26.57	36.93	2.61	7.84	6.95	401.62
Aho2k(x)sc	28–40	1.48	1.91	34.56	36.47	4.28	15.79	20.07	5.35	34.51	39.86	2.56	6.59	6.31	253.97
BCksc	40–48	3.19	3.42	31.52	34.94	6.98	17.20	24.18	11.91	24.28	36.19	2.64	6.04	5.56	138.07
ABksc	48–70	4.26	5.88	30.98	36.86	8.35	10.11	18.46	18.16	20.59	38.75	2.62	5.41	5.29	53.29
Cksc	70–75	3.88	7.69	31.83	39.52	7.51	5.78	13.29	23.82	17.79	41.61	2.67	6.17	5.43	60.51
	M1	3.06	4.49	34.51	39.00	7.36	12.18	19.55	14.69	21.77	36.47	2.61	6.89	6.14	268.73
	M2	2.88	4.18	37.57	41.75	8.14	12.14	20.29	14.54	18.42	32.96	2.60	8.01	6.81	458.43
	M3	3.77	5.66	31.44	37.10	7.61	11.03	18.64	17.96	20.88	38.85	2.64	5.87	5.42	83.95
Profile IS.2: Hortic Anthrosol Mixied-Proxicalcaric															
Aho1k(x)sc	18–28	2.17	2.36	35.75	38.11	5.91	17.24	23.15	9.16	25.10	34.26	2.61	7.68	6.55	380.69
Aho2k(x)sc	28–40	1.75	2.15	30.89	33.04	6.33	16.13	22.46	12.76	27.81	40.57	2.55	6.21	5.73	141.32
Cksc	70–75	4.07	8.15	36.93	45.08	5.93	5.29	11.22	17.33	20.72	38.05	2.69	5.94	5.39	-11.21
	M1	2.66	4.22	34.52	38.74	6.05	12.88	18.94	13.08	24.54	37.62	2.62	6.61	5.89	170.26
	M4	2.86	4.35	34.51	77.75	6.71	12.53	19.24	13.88	23.15	37.04	2.62	6.75	6.01	199.49

H – depth. MG – coarse material (> 2.00 mm). Sand: 2.00 – 0.02 mm; Ng – coarse sand: 2.00-0.20 mm; Nf – fin sand: 0.20 – 0.02 mm. Dust: 0.020 – 0.002 mm; Pg – coarse dust: 0.020 – 0.010 mm; Pf – fin dust: 0.010 – 0.002 mm. Clay (< 0.002 mm): Ag – coarse clay: 0.002 -0.001 mm; Af – fin clay: < 0.001 mm. ρ - absolute density (picnometric method; dispersion liquid: benzene). PH(H_2O) – determined in aqueous suspension. pH(KCl) – determined in 0.1 N KCl (electrodes: pH – calomel). Eh – redox potential (platinum – calomel electrodes). M1 – profile average. M2 – average of superior horizons (Ap1k, Ap2k, Aho1k). M3 – average of inferior horizons (BCk, ABk, Ck). M4 – average of the studied perimeter (span no. 16, Copou – Iaşi glasshouse).

Table 2

Chemical-mineralogical composition (%, w / w – towards soil sample) of soils from Copou – Iaşi glasshouse (IS.1 and IS.2 profiles)

Horizons	Clay minerals							Cb	FeOx.	SiO_2	Organic compounds				
	Crystalline					Amf	Total	Total	Total	Total	Humus			OOC	Total
	Kal	Smc	Illt	OCM	Total						HA	FA	Total		
Profile IS.1: Hipohortic Entianthrosol Mixed-Proxicalcaric															
Ap1ksc	7.36	13.28	15.34	0.61	36.59	3.43	40.02	4.21	2.61	5.63	7.83	1.29	9.17	0.08	9.26
Ap2ksc	7.24	13.52	14.17	0.85	35.78	3.15	38.93	3.96	2.94	5.15	9.64	1.46	11.17	0.13	11.31
Aho1ksc	6.58	17.85	13.56	0.91	38.90	4.72	43.62	2.75	3.36	4.87	6.75	2.66	9.49	0.10	9.60
Aho2k(x)sc	3.36	21.32	12.43	2.15	39.26	7.58	46.84	2.16	3.79	7.48	5.40	4.52	10.03	0.37	10.41
BCksc	6.56	16.47	15.26	0.68	38.97	3.83	42.80	8.65	2.82	6.05	3.98	2.81	6.83	0.12	6.96
ABksc	8.12	15.77	16.75	0.83	41.47	4.15	45.62	4.07	1.94	2.76	3.94	2.99	6.99	0.18	7.18
Cksc	9.45	14.85	20.37	0.75	45.42	3.35	48.77	10.28	2.53	5.63	2.04	1.52	3.57	0.03	3.61
M1	6.95	16.15	15.41	0.96	39.48	4.31	43.80	5.15	2.85	5.36	5.65	2.46	8.18	0.14	8.33
M2	7.06	14.88	14.35	0.79	37.09	3.76	40.85	3.64	2.97	5.21	8.07	1.80	9.94	0.11	10.05
M3	8.04	15.69	17.46	0.75	41.95	3.77	45.73	7.66	2.43	4.81	3.32	2.44	5.80	0.11	5.91
Profile IS.2: Hortic Anthrosol Mixied-Proxicalcaric															
Aho1k(x)sc	7.13	13.60	14.09	0.78	35.60	5.08	40.68	3.11	3.18	5.29	6.56	2.47	9.10	0.12	9.23
Aho2k(x)sc	4.52	20.88	14.11	1.97	41.48	6.14	47.62	2.53	3.45	7.54	5.63	4.69	10.41	0.33	10.75
Cksc	10.97	11.41	18.29	0.57	41.24	3.61	44.85	7.90	2.39	7.10	1.83	1.28	3.13	0.02	3.16
M1	7.54	15.29	15.49	1.10	39.44	4.94	44.38	4.51	3.00	6.64	4.67	1.20	7.55	0.15	7.71
M4	7.24	15.72	15.45	1.03	39.46	4.62	44.09	4.83	2.93	6.00	5.16	1.83	7.86	0.15	8.02

Kal. – kaolinite. Smc. – smectites. Illt. – Illites. OCM – other clay minerals. Amf. – amorphous clay minerals. Cb. – carbonates. SiO_2 – silica. HA – huminic acids. FA – fulvici acids. OOC – other organic compounds.

CONCLUSIONS

The Ahok(x) horizons which are formed in Copou – Iaşi glasshouse, at the depth of 20-40 cm have good expresses frangipane properties and determined a severe segregation of the dynamics of pedo-geochemical processes.

The particularity of pedo-geochemical segregation horizon from Copou-Iaşi glasshouse is given by the relatively high contents of: (**i**) organic phosphorus as inositol-phosphoric esters. (**ii**) fulvic acids and (**iii**) organic-mineral complexes.

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