DOI: 10.22620/agrisci.2011.05.007

ВЛИЯНИЕ НА ЧЕРНОМОРСКИТЕ САПРОПЕЛИ ВЪРХУ НЯКОИ ПОЧВИ С НЕБЛАГОПРИЯТНИ ФИЗИКО-ХИМИЧНИ СВОЙСТВА И ВОДНО-ВЪЗДУШЕН РЕЖИМ
INFLUENCE OF BLACK SEA SAPROPELLES ON SOME SOILS WITH UNFAVORABLE PHYSICO-CHEMICAL PROPERTIES AND WATER-AIR REGIME

Николай Николов[1]*, Недялка Артинова[1], Димитър Димитров[2]
Nikolay Nikolov[1]*, Nedyalka Artinova[1], Dimitar Dimitrov[2]

[1]Аграрен университет – Пловдив
[2]Институт по океанология - Варна
[1]Agricultural University - Plovdiv
[2]Varna Institute of Oceanology

***E-mail: oridel@abv.bg**

Резюме

Направено е проучване за ефекта от прилагането на черноморски сапропели за подобряване на реакцията на канелена псевдоподзолиста почва (Planosol), взета от землището на с. Златосел, Пловдивски регион, а също и за повишаване на пределната полска влагоемност (ППВ) на лесивирана канелена почва (Chromic Luvisol). Получените резултати показват, че в количества 10 g/kg и 20 g/kg сапропелите неутрализират киселинността на канелената псевдоподзолиста почва (Planosol) от 4,5 до 7,3 pH единици. В количество 10-50 g/kg сапропелите повишават пределната полска влагоемност (ППВ) на лесивирана канелена почва (Chromic Luvisol) от 34 g/kg до 244 g/kg в сравнение с контролата.

Abstract

A study was made on the effect of application of sapropelles for improving the reaction of cinnamonic pseudopodzolic soil (Planosol), taken from the land of the village of Zlatosel, the district of Plovdiv, as well as for increasing field moisture capacity (FMC) of leached cinnamonic soil (Chromic Luvisol). The obtained results showed that in amounts of 10 g/kg and 20 g/kg, sapropelles neutralize soil acidity of cinnamonic pseudopodzolic soil (Planosol) from 4,5 to 7,3 pH units. In amounts of 10-50 g/kg sapropelles increase field moisture capacity of leached cinnamonic soil (Chromic Luvisol) from 34 g/kg to 244 g/kg, as compared to the control.

Ключови думи: черноморски сапропели, почвена киселинност, неутрализация, пределна полска влагоемност, канелена псевдоподзолиста почва (Planosol), лесивирана канелена почва (Chromic Luvisol).
Key words: Black sea sediments, sapropelles, soil acidity, neutralization, field moisture capacity, cinnamonic pseudopodzolic soil (Planosol), leached cinnamonic soil (Chromic Luvisol).

Abreviations: CPS - cinnamonic pseudopodzolic soil (канелена псевдоподзолиста почва)
LCS - leached cinnamonic soil (лесивирана канелена почва)
FMC - field moisture capacity (пределна полска влагоемност)

INTRODUCTION

The deep water Black Sea sediments (sapropelles) represent an unique nature phenomena. Their origin have started 11 000 years ago, when strong salt waters have passed into Black Sea, after an ecological cataclysm. As a consequence the more from the available flora and fauna perished and formed about a 2 meters sediment on the sea bottom (1,2).

During last years, sapropelles are a subject of special research, because of opportunity for their application in several aspects of agriculture, related to the soil fertility. (3,4) According to literature data from about 46 millions dca cultivated agriculture lands, 3,5 milions are classified as strong acidic (pH=4,1-4,6), and 4,6-5,0 millions – as acidic soils (pH=4,6-6,0) as a consequence of long standing using of nitrogen fertilizers, acidic rains, waterlogging etc.,

leading to disruption of soil structure. (6) In fact more than 8 millions dca lands need a chemical recultivation (6) Another important factor influencing soil fertility is their FMC, related to normal growing of agricultural crops.

The aim of present work was to study the opportunity of using of sapropelles for neutralization of CPS (Planosol) and for increasing of field moisture capacity (FMC) at LCS (Chromic Luvisol).

MATERIAL AND METHODS

1. Elemental analysis

Sample sapropelles, taken from a depth 1200 m was analysed for the content of Si, K, P , Ti , Al, Ca, Na., as well as some microelements, as Fe, Mn, Mg, Cr, Mo, Cu, and heavy metals Zn, Ni, Pb. They were determined in the form of oxides. An inductively coupled emission spectrometry (Jobni Yvon Emission - JY 38 S. France) was used. The quantitative measuring was carried out with apparatus ICP.

2. Neutralization of soil acidity at CPS (Planosol) with sapropelles

In banks were set 30 g samples of acidic soil - CPS (Planosol), taken from three deep horizons (0-10 cm, 10-28 cm, 28-40 cm) of Zlatosel village land (Plovdiv district), with pH in borders 4,5-4,7. Samples were mixed with sapropelles at an amount 10 g/kg and 20 g/kg. After pouring on with 30 ml double distilling water, samples were left for incubation. The samples were periodically filled up with distilling water and mixed. During the incubation, the banks were closed to avoid an access of atmospheric air. After incubation period of 45 days at 303 K were determined pH of the detached varieties in H_2O and 1n KCl medium. The pH values of the tested samples were determined with a pH meter, Model OP-211/1 (ISO 10390). Parallel were established pH value of sample sapropelles used and control samples.

3. Determination of humus content, calcium carbonate and exchange ions

The humus content in the three soil horizons of CPS (Planosol) as well as in the soil-sapropelles mixtures and in sample pure sapropelles was determined by the method of Turin (7). The content of active calcium carbonate was established by the method of Druino and Gale (7). The content of exchange ions - Ca^{2+}, Mg^{2+}, Al^{3+} and H^+ was determined by standard method in extract of 1n KCl (7).

4. Field moisture capacity (FMC) of LCS – sapropelles mixtures

Field moisture capacity of soil-sapropelles mixtures was determined by the method of Kabaev (5). The mixtures contain average sample of LCS (Chromic Luvisol), taken from Otetz Kirilovo village land, Plovdiv district (deep horizon 0-40 cm) and different amounts of sapropelles in borders from 10 g/kg to 50 g/kg.

RESULTS AND DISCUSSION

The data from the elemental analysis of sapropelles are shown at tables 1, 2. The content of macro- and microelements was established, calculated as oxides. The data show that content of calcium - 154,6 g/kg, calculated as CaO is more than its content in the most soil types. The content of some other basic elements as Mg, Mn, Fe exceeds their content in soils too. The lost by heating at 1273 K, (table 2) was 199,7 g/kg, because of presence of organic matter and carbonates.

The results obtained during the study was shown that the change of soil acidity after 45 days incubation period, by temperature 303 K, depends on the content of sapropelles. At the control samples pH vary from 4,5 to 4,7 at H_2O medium and from 3,90 to 3,80 at 1n KCl solution medium. By content 10 g/kg sapropelles, pH changes from 6,4 to 7,0 at H_2O medium and from 5,45 to 6,6 at 1n KCl

Table 1. Chemical composition of sapropelles. Content of microelements

№	Sample oxides	Cr g/t	Mo g/t	Zn g/t	Mn g/t	Pb g/t	Cu g/t	Ni g/t
1	Sapropelles	50,00	36,40	65,82	383,42	28,22	36,63	49,75

Table 2. Chemical composition of sapropelles. Content of micro- and macroelements

Sample oxides	SiO_2 g/kg	TiO_2 g/kg	Al_2O_3 g/kg	FeO g/kg	MnO g/kg	MgO g/kg	CaO g/kg	Na_2O g/kg	K_2O g/kg	Loss by 1273 K g/kg
Sapropelles	397,6	7,0	116,9	45,7	0,4	26,8	154,6	21,3	1,83	199,7

Table 3. General chemical composition and physical-chemical properties of CPS (Planosol), sapropelles and their mixtures

Samples Horizon depth (cm)	pH		Humus content (g/kg)	$CaCO_3$ (g/kg)
	in H_2O medium	in KCl solution		
Control – CPS (Planosol)				
A_1A_2l 0-10	4,50	3,90	12,1	-
A_2l 10-28	4,50	4,00	4,8	-
A_2l(g) 28-40	4,70	3,80	3,1	-
Sapropelles				
Sapropelles	7,24	6,95	68,6	62,2
CPS (Planosol) + 10 g/kg sapropelles				
A_1A_2 0-10	6,4	5,45	15,6	0,62
A_2l 10-28	6,9	6,55	5,4	0,63
A_2l(g) 28-40	7,0	6,6	3,7	0,62
CPS (Planosol) + 20 g/kg sapropelles				
A_1A_2l 0-10	7,0	6,55	15,6	1,24
A_2l 10-28	7,2	6,80	12,7	1,26
A_2l(g)28-40	7,3	7,00	5,3	1,24

Table 4. Exchange ions content of cinnamonic pseudopodzolic soil (Planosol) with sapropelles after 45 days incubation

Content of sapropelles (g/kg)	№	Horizon, depth (cm)	Exchange ions (mgeq/100 g)			
			$\Sigma(Ca^{2+}, Mg^{2+})$	Ca^{2+}	$\Sigma(Al^{3+}, H^{+})$	Mg^{2+}
10	1	0-10	5,77	4,367	0,05	0,90
	2	10-28	6,13	2,964	0	3,16
	3	28-40	3,87	3,849	0,07	0,02
20	4	0-10	6,84	2,655	0	4,18
	5	10-28	7,19	5,973	0	1,22
	6	28-40	5,31	3,894	0	1,42
Control CPS (Planosol)	7	0-10	31,3	25,0	98,2	6,3
	8	10-28	36,8	17,5	109,3	19,3
	9	28-40	37,5	15,6	96,2	21,9

Table 5. Field moisture capacity (FMC) of soil-sapropelles mixtures containing leached cinnamonic forest soil (Chromic Luvisol) and different amount of sapropelles

Horizon Depth of LCS (cm)	Sample №	Variants LCS + sapropelles (g/kg)	FMC (%) in comparison to Control
0-40	1	10	103,4
	2	20	112,1
	3	30	117,3
	4	50	124,4
	5	Control	100

medium. By 20 g/kg sapropelles, pH reaches values 7,0-7,3 units and 6,55 to 7,0 at 1n KCl medium respectively. The established pH change is related to the content of humus and exchange ions at the samples, containing sapropelles. The presence of organic carbon and exchange ions (Ca^{2+}, Mg^{2+} etc.) at the sapropelles composition, assure high neutralization ability against the investigated strong acidic Planosol (table 3, 4).

It was established that at an amount 10-50 g/kg sapropelles increase FMC of leached cinnamonic soil (Chromic Luvisol) from 34 g/kg to 244 g/kg in comparison to control sample (table 5). The most significant increasing of FMC was established at 50 g/kg added sapropelles, according to the correlation soil: sapropelles. The raised FMC can be explained by the improved water-air regime at the tested soil - sapropelles samples. In fact sapropelles improve the soil structure, which determine more higher inner-aggregate porosity.

CONCLUSIONS

1. Sapropelles neutralize soil acidity of cinnamonic pseudopodzolic soil (Planosol) from 4,5-4,7 to 7,0-7,3 pH by insignificant amount of sapropelles – 10 g/kg and 20 g/kg.
2. At an amount from 10 g/kg to 50 g/kg sapropelles improve the FMC of leached cinnamonic soil (Chromic Luvisol) from 34 g/kg to 244 g/kg in relation to the control samples.
3. The study show that sapropelles could be used for recultivation of acidic soils and for increasing of FMC when the soil moisture is insufficient.

REFERENCES

Bmins, T. S., 1994. The Black Sea Sapropelloide slim. Composition, geneses and perspectives of its using Dissertation, OM GOR, CNPM, NANU, p. 258.

Dimitrov, P., V. Velev, 1988. Opportunities of using of deep-water sapropelloide slimes of Black Sea for agrobiological and industrial purposes. – Oceanology, 17, Sofia.

Dimitrov, P. N. Nikolov, N. Artinova, N. Shaban, M. Kamburova, Cv. Moskova, P. Zapryanova, D. Dimitrov, D. Solakov, 2000. Amendment for soils and substrates, BG Patent № 63868, 3.

Dimitrov, P., D. Dimitrov, D. Solakov, 1999. Application of Black Sea bottom sediments for natural ecological fertilizer and recultivation of exhausted soils. – In: Intern. Conference Geology and Mineralogy Resources of The Black Sea, Kiev, 24-28 November, 182, p. 418.

Georgiev, G., K. Darjanov, S. Dulov, N. Uzunov, A. Ovcharova, 1991. Manual of agriculture land improvement, Zemia, Sofia, p. 178.

Koteva, V., N. Artinova, 1993. An influence of the long standing mineral fertilizing on the content of humus in cambisol in South-East Bulgarian. – Soil Science, Agrochemistry, Ecology, 28, 13-16.

Trendafilov, K., R. Popova, 2007. Manual for soil science, Acad.Publ.Agriculture Univ., Plovdiv, p. 95; 102; 144.

Статията е приета на 8.02.2011 г.
Рецензент – доц. д-р Рада Попова
E-mail: radapopova@abv.bg