От редакции

В конце июня 2009 года в Киеве состоялся украинско-болгарский семинар на тему «Нетрадиционные ресурсы со дна Черного моря и возможности их использования как комплексного сырья», в работе которого приняли участие ученые Киева (ГНУ «Отделение морской геологии и осадочного рудообразования», Институт физиологии растений НАН Украины, Институт земледелия НАА Украины), Варны (Институт океанологии БАН) и Софии (Институт физиологии растений БАН).

На семинаре были обсуждены результаты исследований, выполняемых научными коллективами в рамках одноименного совместного украинско-болгарского проекта, и пути дальнейшего развития этого проекта.

Тезисы докладов, опубликованные в этом номере журнала, подготовлены по итогам обсуждения и освещают результаты опытов применения сапропелей для рекультивации почв и активизации роста и развития некоторых видов сельскохозяйственных культур.

Сапропели – специфический тип осадков, которые на голоценовом этапе развития Черного моря сплошным покровом легли на дно глубоководной впадины и отдельными «пятнами» локализовались на шельфе. Эти органо-минеральные осадочные образования (более ста лет известные под названием сапропелевых, кокколитовых и диатомовых илов) начали системно и целенаправленно изучаться в начале 90-х годов прошлого века. Они представляют собой потенциально перспективное сырье с широким диапазоном применения – в земледелии, медицине, фармакологии, строительстве, производстве керамики и т.п. Их комплексное изучение, одновременно проводимое учеными Украины и Болгарии, простимулировано актуальностью практических потребностей национальных экономик.

На сегодняшний день исследования в основном сосредоточены на: геологическом изучении глубоководных органо-минеральных осадков; определении возможных областей их применения; изучении горно-технических условий добычи и разработке технических средств для отбора крупномасштабных проб; оценке воздействия на морскую среду геолого-разведочных и эксплуатационных работ.

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Studying on the Influence of the Black Sea Sapropelles on the Quality and Content of Humus in Cinnamonic Pseudopodzolic Soil (Planosol)

During last years, agricultural specialists rise a question of soil humus content. Assimilation of uncultivated agriculture lands as rule leads to decreasing soil humus content in the tillablle horizon. It could be explained by disturbance of nature biological stuffs cycle, because of bringing out biomass by the crops, or by mechanical movement of plant covering-organogenesis horizon and humus-assimilating horizon with one, deeper lying, poor in humus. A similar phenomena processes in soils, where tillablle horizon don't go out the borders of humus-assimilating horizon as in the case of cambisols. That's why the most probably reason for humus decrease is the cultivation and related to it mineralization of organic matter. By such facts is clear that in parallels to using soils with weak accumulation of organic matter, is necessary to trouble about humus content stabilization.

The aim of present work was to establish the influence of substrates, containing sapropelles at the humus state in low-fertile soils as cinnamonic pseudopodzolic soils (CPS), (Planosol), in relation to support an optimal balance of organic stuff.

1. Chemical composition of sapropelles. To determine the macro- and microelements content in the sample of the used sapropelles, inductively coupled emission spectrometry (Jobni Yvon Emission – JY 38 S. France) was used. The quantitative measures were carried out with ICP.

Tables 1, 2 illustrate the content of macro and microelements in the used sample of sapropelles. The loss while heated at 1000° C is 19,97%, due to a content of organic matter.

2. As object of investigation was used CPS (Planosol), taken from the Zlatosel village area (Plovdiv region). Soil samples from a surface soil horizon and both undersurface layers of SFPS were incubated with sapropelles amount of 1,0 % and 2,0 % in form of water-mechanical suspension. The incubation was kept at room temperature with full soil water storage over a periods 1, 2

Table 1

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)
Sapropelles	50.00	36.40	65.82	383.42	28.22	36.63	49.75

Table 2

Chemical composition of sapropelles

Sample Oxides	SiO_2 (%)	TiO_2 (%)	Al_2O_3 (%)	FeO (%)	MnO (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	Loss (%), 1000°C
Sapropelles	39.76	0.70	11.69	4.57	0.04	2.68	15.46	2.13	1.83	19.97

Table 3

Content and fractional composition of humus after 45 days incubation of sapropelles in planosol

Deep of horizon (cm)	Total C_{org} (%)	% C_{org} from C_t				Insoluble residue (%)	C_{ha}/C_{fa}	%C from C_{org} of humic acids	
		Extracted with 0,1n H_2SO_4	Extracted with $Na_2P_2O_7$/NaOH					Free and bound with R_2O_3 h.a	Bound with Ca humic acids
			Generally	Humic acids	Fulvo acids				
0-10	0,70	0,059 / 8,33	0,34 / 48,39	0,176 / 20,77	0,195 / 27,65	0,364 / 51,60	0,75	83,08	16,95
10-28	0,28	0,105 / 37,10	0,148 / 52,20	0,053 / 18,62	0,095 / 33,92	0,135 / 47,79	0,56	100,00	0,00
28-40	0,18	0,086 / 48,00	0,096 / 53,46	0,039 / 21,76	0,057 / 31,70	0,083 / 46,54	0,68	13,59	86,41
Sapropel 1	4,031	-	O,6148 / 15,25	0,1261 / 3,13	0,4887 / 12,12	3,4162 / 84,75	0,26	0,00	100
Sapropel 2	3,98	-	0,5836 / 14,66	0,1223 / 3,07	0,4613 / 11,59	3,3964 / 85,34	0,26	0,00	100
Sapropel 3	3,92	-	0,5690 / 14,51	0,1187 / 3,03	0.4503 / 11,49	3,351 / 85,48	0,26	0,00	100

Notice: C_T – Total content of carbon, C_{org} - organic carbon, C_{ha}/C_{fa} – correlation between C of humic acids and C of fulvo acids

Table 4

Content and fraction composition of humus in cinnamonic pseudopodzolic soil, incubated with sapropel in 45 days duration

Content of sapropelles (%)	Deep of horizon (cm)	Total C_{org} in soil (%)	% C_{org} from C_t						% C_{org} from C_t H. acids extract. with 0,1n NaOH	
			Extracted with 0,1n H_2SO_4	Extracted with 0,1M $Na_2P_2O_7$ + 0,1n NaOH			Non-hydrolized residue	C_{ha}/C_{fa}	Free and bound with R_2O_3	Bound with Ca
				Total C	Humic acids	Fulvo acids				
1,0	0 - 10	0,905	$\frac{0,075}{8,29}$	$\frac{0,295}{32,6}$	$\frac{0,108}{11,93}$	$\frac{0,187}{20,66}$	$\frac{0,61}{67,4}$		$\frac{0,108}{100}$	–
	10 – 28	0,312	$\frac{0,057}{18,27}$	$\frac{0,235}{75,32}$	$\frac{0,0820}{26,28}$	$\frac{0,153}{49,04}$	$\frac{0,077}{24,68}$	0,53	$\frac{0,0821}{100}$	–
	28 – 40	0,218	$\frac{0,104}{47,71}$	$\frac{0,15}{68,81}$	$\frac{0,064}{29,36}$	$\frac{0,086}{39,45}$	$\frac{0,068}{31,19}$	0,74	$\frac{0,038}{59,37}$	40,63
2,0	0 – 10	0,905	$\frac{0,075}{8,29}$	$\frac{0,28}{30,94}$	$\frac{0,086}{9,50}$	$\frac{0,194}{21,44}$	$\frac{0,625}{69,06}$	0,44	$\frac{0,0851}{98,95}$	1,05
	10 – 28	0,739	$\frac{0,0818}{11,07}$	$\frac{0,23}{31,12}$	$\frac{0,076}{10,28}$	$\frac{0,154}{20,84}$	$\frac{0,509}{68,88}$	0,49	$\frac{0,0736}{96,842}$	3,1587
	28 – 40	0,307	$\frac{0,0614}{20,00}$	$\frac{0,14}{45,60}$	$\frac{0,062}{20,20}$	$\frac{0,078}{25,41}$	$\frac{0,167}{54,4}$	0,79	$\frac{0,0194}{31,29}$	68,71

Notice: The values of numerators of fractions are absolute %, and in undermarks – relative %.

and 3 months. Manifest alterations in quality of soil humus were established in a month after incubation. The humus content was established by an express method of Cononova and Belchikova. Independently of express character of the mentioned method, some additional analyses were made after 45 days incubation. As test about humus state of samples were used data of humus indexes parameters (Orlov and Grishina), adopted according the diapason of values in Bulgarian soils (Artinova).

It was established that in a layer 0–10 cm, the content of organic carbon (C_{org}) increases 0,2% by both varieties of samples (1,0%, 2,0% sapropelles) and about 0,1–0,4% in deeper layers with the second variant, containing 2,0%. The humic acids content showed a tendency to decreasing with increasing insoluble humic residue. The part of humic acids, bound with calcium, decrease especially at the variety with 1,0% sapropelles. It prove the mobilizing action of Fe^{3+} and Al^{3+} in sapropelles composition on the humic acids of non-forming organic stuff and the opposite effect – fixation and immobilization of the organic components of non-hydrolized residue (humin) of Ca^{2+} & Mg^{2+}. The experimental data are shown at tables 3, 4.

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Use of the Black Sea Sapropelles as Amendment by Growing Index of the Vegetable Crops Tomatoes, Paprika and Aubergine

The effect of introduction of the Black sea sapropelles was studied by production of seedlings of the vegetable crops tomatoes, paprika and aubergine. It was established their influence on the following growing indices: height and width of the central stem and number of leaves.

Chemical composition of sapropelles and content of microelements are shown in the article presented by N. Artinova, N. Nikolov, D. Dimitrov, P. Dimitrov.

The trials were settled 10 plants in variant, every of them in five replications. Air dry sapropelles, screened by sieve 1 mm amount of 0,2% - variant I, 0,4% - variant II and 0,6% - variant III, was added to a soil-manure mixture and regularly irrigated. Kind of the soil used was Vertisol. The correlation soil: manure was 1:1. After incubation period of a month, the plants of vegetable crops tomatoes paprika and aubergine were planted out in plastic plant pots with diameter 100 mm and an amount of the soil-manure mixture — 0,5 kg.

The analysis for the results of pH (H_2O medium) values of the manure-soil mixtures was shown that pH increases to the neutral area, in dependence of the incubation period and the content of sapropelles. This is the most expressed by the varieties with 0,6% . The change was significant after a month and after two months was insignificant (table 1).

It was established that sapropelles increase the water storage capacity (WSC) of samples, in borders 1,12% – 4,60% , in dependence of the content of sapropelles (table 1).

The results of biometric analyses are summarized in tables 2–10.

Table 1

Water storage capacity and pH of the incubated with sapropelles manure-soil samples

№	Variants	pH (H_2O) after time		WSC (%)
		one month	two months	
1	I	6,74	6,77	101,12
2	II	6,83	6,86	102,55
3	III	6,95	6,97	104,60
4	Control	6,1	6,05	100

Table 2

Height of the central stem at the tomato plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to Control	% to the median value
1	Control	18,2	1,68	10,38	100	91
2	I	19,0	4,02	23,73	104	95
3	II	22,2	2,03	10,27	122	111
4	III	20,3	3,47	19,16	112	102
5	$\overline{X}$	19,92				

Table 3

Width of the central stem at the tomato plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to the Control	% to the median value
1	Control	0,44	0,01	11,36	100	96
2	I	0,46	0,01	10,56	105	100
3	II	0,46	0,01	10,86	105	100
4	III	0,48	0,03	8,33	109	104
5	$\overline{X}$	0,46				

Table 4

Number of leaves at the tomato plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to the Control	% to the median value
1	Control	5,4	0,48	10	100	87
2	I	5,6	0,48	9,64	104	90
3	II	7,6	0,48	7,10	141	123
4	III	6,2	0,39	7,09	115	100
5	$\overline{X}$	6,2				

Table 5

Height of the central stem at the paprika plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to the Control	% to the median value
1	Control	16,3	4,67	24,78	100	119
2	I	15,8	6,90	37,78	97	116
3	II	11,0	2,08	16,36	67	80
4	III	11,6	2,40	17,83	71	85
5	$\overline{X}$	0,28				

Table 6

Width of the central stem at the paprika plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to thye Control	% to the median value
1	Control	0,3	0	0	100	107
2	I	0,3	0	0	100	107
3	II	0,26	0,067	22,30	87	93
4	III	0,26	0,067	22,30	87	93
5	$\overline{X}$	0,28				

Table 7

Number of leaves at the paprika plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to the Control	% to the median value
1	Control	9,66	0,65	5,90	100	95
2	I	110,0	1,15	10,00	104	98
3	II	10,33	0,65	5,51	107	102
4	III	10,66	1,32	10,78	110	105
5	$\overline{X}$	10,16				

Table 8

Height of the central stem at the aubergine plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to the Control	% to the median value
1	Control	8,6	0,67	6,74	100	76
2	I	12,16	2,72	19,40	141	107
3	II	13,5	0,57	3,70	157	119
4	III	11,3	0,65	5,04	131	99
5	$\overline{X}$	11,39				

Table 9

Width of the central stem at the aubergine plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to Control	% to the median value
1	Control	0,40	0	0	100	93
2	I	0,46	0,067	12,60	115	107
3	II	0,43	0,06	13,25	108	100
4	III	0,43	0,06	13,25	108	100
5	$\overline{X}$	0,43				

Table 10

Number of leaves at the aubergine plants

№	Varieties	Median value	$2S/\sqrt{n}$	V.C.	% to Control	% to the median value
1	Control	5,0	0	0	100	100
2	I	6,0	0	0	120	120
3	II	4,33	0,66	13,30	87	87
4	III	4,66	0,66	12,36	93	93
5	$\overline{X}$	4,99				

Acknowledgements. This work was done at the support of the National Science Fund of the Ministry of Education and Science, (Bulgaria – Ukraine Project: No 02 – 35 “Non-traditional resources from Black sea bottom and their possibilities to use as complex raw material”).

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Use of The Black Sea Sapropelles for Improvement of Rooting and Growth of Kazanlika Oil-bearing Rose Clips

Oil bearing rose “Kazanlika” is the most important and essential oil crop in Bulgaria. For a pity the rose plantations decrease in the last decades, leading to decreasing of rose oil production. The main method for seedlings production is the rooting of rose clips in various substrates in glasshouse conditions. There are two technologies of seedlings production – Rooting of green clips by spraying in peat-perlite substrate and rooting of ripe clips without spraying. The first method is more effective but require more investments. By the second the percent of rooted clips is lower in comparison to the first method.

A study was made on the effect of the Black Sea sapropelles application at a stimulation the rooting and the median growth of the rooting clips of Kazanlika oil-bearing rose.

The experiment was carried out with two substrates enriched by sapropelles - variant I, represents perlite + 3,0% sapropelles and variant II –

peat – perlite substrate in correlation 1:1 + 3,0% sapropelles. For comparison was used two etalon substrates – balcanin-zeolite substrate and mineral mixture for tomatoes. The number of the examined clips at all variants was 80. After six months rooting the percent of rooted clips and their growth was established.

The data are summarised in table

Median growth and percent of rooted oil-bearing rose clips in nutrient substrate enriched by sapropelles

Variants	Number of clips	Substrate Composition	Median growth of rose clip, cm	Rooted clips (%)
I	80	perlite + 3 mass.% sapropelles	6,04	90
II	80	peat:perlite 1:1 + 3 масс.% sapropelles	21,76	95
Etalon I	80	Balcanin-zeolite substrate	10,75	80
Etalon II	80	Mineral mixture for tomatoes	18,18	85

The established stimulation effect on the rooting of the clips can be explained by the rich content of microelements and organic stuffs in the composition of sapropelles.

Chemical composition of sapropelles and content of microelements are shown in the article presented by N. Artinova, N. Nikolov, D. Dimitrov, P. Dimitrov.

The data analysis was shown that sapropelles stimulate the risogeneses of oil-bearing rose clips and can be applied by seedlings production of "Kazanlika" oil-bearing rose.

Acknowledgements. This work was done at the support of the National Science Fund of the Ministry of Education and Science, (Bulgaria – Ukraine Project: No 02 – 35 "Non-traditional resources from Black sea bottom and their possibilities to use as complex raw material").

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Use of The Black Sea Sapropelles for Neutralization of Soil Acidity and Increasing of Water storage Capacity of Soils

Chemical composition of sapropelles and content of microelements are shown in the article presented by N. Artinova, N. Nikolov, D. Dimitrov, P. Dimitrov.

1. Neutralization of acidity of cinnamonic pseudopodzolic soil (Planosol).

In banks were set 30 g samples of acid cinnamonic pseudopodzolic soil (Planosol), taken from three deep horizons in the Zlatosel village area (Plovdiv district), with pH 4,5 – 4,7. Samples were mixed with sapropelles 1,0 % and 2,0 %. After pouring on with 30 cm^3 double distilling water, samples were left for incubation.

After incubation period of 45 days pH of the detached varieties in H_2O and KCl medium were determined.

In parallels were established pH value in the control samples out of three horizons and in the sapropelles. It was established the humus content in all analyzing samples. The experimental data are shown at table 1. It was established the content of exchangeable ions in the samples. The results are shown at table 2.

Table 1

General chemical composition and physical-chemical properties of cinnamonic pseudopodzolic soil (Planosol), sapropelles and their mixtures

Horizon depth (cm)	pH		Humus content (%)	$CaCO_3$ (%)
	in H_2O medium	in KCI solution		
Control – CPS (planosol)				
$A_1A_2l(g)$ 0-10	4,50	3,90	1,21	-
$A_2l(g)$ 10- 28	4,50	4,00	0,48	-
$A_2l(g)$ 28-40	4,70	3,80	0,31	-
Sapropelles				
Sapropelles 1	7,28	6,70	6,95	6,20
Sapropelles 2	7,25	6,95	6,86	6,22
Sapropelles 3	7,20	7,20	6,76	6,18
CPS (planosol) + 1,0 % sapropelles				
$A_1A_2l(g)$ 0-10	6,4	5,45	1,56	-
$A_2l(g)$ 10-28	6,9	6,55	0,54	-
$A_2l(g)$ 28-40	7,0	6,6	0,37	-
CPS (planosol) + 2,0 % sapropelles				
$A_1A_2l(g)$ 0-10	7,0	6,55	1,56	-
$A_2l(g)$ 10-28	7,2	6,80	1,27	-
$A_2l(g)$ 28-40	7,8	7,00	0,53	-

Table 2

Exchangable ions content in cinnamonic pseudopodzolic soil (Planosol) with sapropelles after 45 days incubation

Content of sapropelles (%)	№	horizon depth (cm)	Exchange ions (mgeq/100 g)			
			$\sum(Ca^{2+}, Mg^{2+})$	Ca^{2+}	$\sum(Al^{3+}, H^{+})$	Mg^{2+}
1,0	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
2,0	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

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+}) at the sapropelles composition, improve the buffer ability of the investigated Planosol.

2. Establishing water storage capacity (WSC) of leached cinnamonic soil (Chromic Luvisol) with addition of sapropelles.

The WSC of the tested kind of soil was determined by standard method. In glasses with volume 250 cm^3 were set 30 g samples of leached cinnamonic soil (Chromic Luvisol), from horizon depth 0-40 cm, with different content of sapropelles – 1,0% - 5,0% . Samples, including control sample, were poured on with 50 cm^3 distilling water and left for 24 hours stay.

The data are shown at table. 3

Table 3

Water storage capacity of leached cinnamonic forest soil (SFS) (Chromic Luvisol) with a different amount of sapropelles

Horizon depth (cm)	Sample №	Variants SFS + sapropelles (%)	WSC (%) in comparison to Control
0-40	1	1,0	103,4
	2	2,0	112,1
	3	3,0	117,3
	4	5,0	124,4
	5	Control	100

In fact sapropelles improve the soil structure, which determine more higher inner-aggregate porosity.

Acknowledgements. This work was done at the support of the National Science Fund of the Ministry of Education and Science, (Bulgaria – Ukraine Project: No 02 – 35 “Non-traditional resources from Black sea bottom and their possibilities to use as complex raw material”).

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Optimizing Nitric Nutrition by Tomatoes Cultivar “Rila” at Plastic House Conditions by Use of Modified Granules, Containing Polymers and Black Sea Sapropelles

The traditional methods of nitrogen nutrition in many cases lead to a number of unfavorable effects on the environment phenomena as increasing soil acidity and pollution of plant production with nitrates, especially by use of ammonium nitrate. A part of ammonium nitrogen can’t be assimilated because of evaporation by decomposition of the salt in soil. The presence of nitrates is a general problem for many European regions. In many built-up areas, the subsoil waters are contamined with nitrates.

The intensive nitrogen nutrition polluted the environment and don't assimilate rationally by the plants, leading to decreased yield and worsen quality of plant production.

The aim of present work was to study the possibility of optimizing nitrogen nutrition by use of modified granules, containing sapropelles as amendment and covered with water swelling polymeric layer.

Chemical composition of sapropelles and content of microelements are shown in the article presented by N. Artinova, N. Nikolov, D. Dimitrov, P. Dimitrov.

Tomato seedlings were plant in two variants, I and II, by four replications (4 x 8 plants). As nitrogen fertilizer were used ammonium nitrate, introduced only ones by modified granules containing 44% ammonium nitrate, 30% Black sea sapropelles as amendment and 26% filler (kaolin). The granules were formed on a rotary plate granulator by spraying 0,5% water solution of polyvinyl alcohol (PVA), if variant I and by 0,5% water solution of modified polyvinyl alcohol (PVA-M) if variant II.

The median data of tomatoes yield from the two year investigation are shown at table 1.

In table 2 is shown the content of vit. C.

Table 1

General standard and median yield of tomatoes cv."Rila" at plastic house conditions by optimized nitric nutrition

Variants	Median data of harvestings at variants (2002-2003) (kg)								General yield (kg)
	1	2	3	4	5	6	7	8	
I	2.10	5,46	8,70	10,30	11,47	13,00	17,50	12,2	80,73
II	2,05	5,50	7,60	10,20	10,25	12,00	15,30	10,79	73,71
Control	0,800	1,500	2,300	5,800	4,600	7,500	11,200	5,600	70,2

Table 2

Content of vit.C in tomatoes, cv. "Rila"

Variants	Number of plants	Content of vitamin C mg/kg
I	32	18,99
II	32	19,39
Control	32	17,78

The established effect on the yield and content of vitamin C in the tomato fruits can be explained by the rich content of macro- and microelements and the organic stuffs in the composition of sapropelles.

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Decreasing Pb, Zn and Cd Accumulation of "Triticalle" Crop from Soil by Use of the Black Sea Sapropelles

The presence of heavy metals in soils leads to a number of abnormal for the environment phenomena. From the soil they pass into the plants and polluted the plant production. Even in more higher concentrations they influent unfavorable on the physiological and biological processes in a plant organism – Kabata.

An important condition for producing pure agriculture production is to avoid or decrease the accumulation of heavy metals to the cultivated crop. It is known that the mobility of heavy metals depends on the soil pH. By the acid soils the number of mobile forms is more that the neutral or weak alkali soils.

The preliminary investigation have shown that the Black Sea sapropelles neutralize significantly the soil acidity and increases the yield at some vegetable crops – P. Dimitrov.

Chemical composition of sapropelles and content of microelements are shown in the article presented by N. Artinova, N. Nikolov, D. Dimitrov, P. Dimitrov.

Table 1

DTPA – Extractable and Total Content of Pb, Zn and Cd in the Soil

№	Element	DTPA extractable	Total content	DTPA -extractable/ total content, %	MPC*
1	Pb	106.8	217.7	49.3	80
2	Zn	145.0	621.8	23.3	340
3	Cd	3.4	7.6	44.7	2,5

Table 2

DTPA - Extractable and Total Content of Pb, Zn and Cd in the Soil

№	Plant parts	Content of Pb, Zn, Cd samples by "Triticalle" culture (mg/kg)					
		Control	soil +1% sapropelles	decreasing to control, %	soil + 3% sapropelles	decreasing to control, %	soil
content of Pb							
1	roots	32,10	30,0	6,50	24,0	25,2	217.7
2	steams	1,90	1,80	5,30	1,30	31,58	
3	leaves	7,80	6,90	11,50	4,30	44,88	
content of Zn							
4	roots	192,4	150,3	29,90	124,20	35,42	621.8
5	steams	69,5	49,1	29,36	23,10	58,78	
6	leaves	131,5	69,5	47,15	24,90	81,10	
content of Cd							
7	roots	2,4	1,9	21,84	1,50	37,50	7.6
8	steams	1,5	0,3	80,0	0,06	96,00	
9	leaves	3,2	0,1	96,87	0.00	100	

The aim of present work is to established the lock ability of Black Sea sapropelles on the mobile forms of heavy metals Pb, Zn, Cd in alluvial-meadow soil (Calcaric Fluvisol).

The total content of Pb, Zn and Cd in soil is high and considerably exceeds the maximum permissible concentrations (Table 1).

The content of Pb, Zn and Cd in harvested culture "triticalle" in different parts - roots, stems and leaves, was determined by use of dry mineralization method.

The data are summarised in table 2.

The results obtained show that sapropelles in content 1,0% – 3,0% can successfully be used for decreasing Pb, Zn and Cd accumulation by "Triticalle" culture.

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