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APPLICATION OF BLACK SEA SAPROPELLES AS AMENDMENT BY GROWING OF VEGETABLE CROP SEEDLINGS

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Abstract

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A study was made on the effect of application of sapropelles as an amendment for vegetable crops. The median results obtained from two years pot plant experiments was shown that in an amount 0.2% - 0.6%, sapropelles improve the growing of seedlings by the vegetable crops tomatoes, paprika and eggplant (a number of leaves, a height and width of the central stem) by the used substrate Vertisol-manure mixture.

Key words: sapropelles, natural fertilizer, tomatoes, paprika, eggplant, Vertisol
Abbreviations: LSH - limited soil hygroscopy; V.C. - variety coefficient

Introduction

The deep water Black Sea sediments (sapropelles) represent unique nature phenomena. Their origin according Dimitrov at al. (1988, 1999), have started 11 000 years ago, when the salt waters have passed to the Black Sea, after an ecological cataclysm. As a consequence the more from the available flora and fauna perished and formed about 2 meters sediments on the sea bottom.

An idea for application of sapropelles in the agriculture practice grounds on the application of lake and marsh sapropelles by Bmins (1994). An important motive for the investigation according Dimitrov at al. (2000) (N. Nikolov and N. Shaban, Personal communication) is the favorable macro- and microcomponential composition of sapropelles. Georgiev (2005) has established that they improve the agrotechnical properties of soils and stimulate the growth of plants. The seedlings production according to Michov at al. (2001) is an important stage of the vegetable crops vegetation, which influents on the quality and the yield of the plant production.

An important condition for obtaining of qualitative seedlings is a mineral nutrition of plants. The nutrition elements in soils and substrates are in comparatively low quantities. The biggest part of them takes an iron - from 300 g/kg^{-1} to 38 g/kg^{-1}, but this element is needed in insignificant quantity. Potassium and calcium are necessary in much more bigger quantities. The average percent of such important for the plants macro-elements as nitrogen and phosphorus is about 40 times less in comparison to the iron. According to Gorbanov at al. (2005) it requires soils and substrates to be

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enriched additionally with organic-mineral fertilizers.

The aim of present work was to study the opportunity for application of sapropelles as a natural fertilizer by growing of seedlings tomatoes, paprika and eggplant.

Material and Methods

Elemental analysis

A sample of sapropelles was taken from a depth 1200 m. The content of К, P, Si, Ti, Al, Ca, Na., as well as some microelements as Fe, Mп, Mg, Cг, Mo, Zn, Mn, Cu, и Ni and the heavy metal Pb was determined in the form of oxides. An inductively coupled emission spectrometry (Jobni Yvon Emission - JY 38 S. France) was used. The quantitative measures were carried out with apparatus ICP.

Pot plant experiment

The trials were settled over 10 plants in variety, every of them in five replications. Air dry sapropelles, screened by sieve 1 mm in an amount 0.2% - variety I, 0.4% - variety II and 0.6% - variety III, was added to a soil-manure mixture and regularly irrigated. The 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 eggplants were planted out in plastic plant pots with diameter 100 mm and an amount of the soil-manure mixture – 0.5 kg. The values of pH after 1 and 2 months incubation of the detached variants in H_2O medium were determined by pH-meter, model OP-211/1, (ISO 10390). The LSH of the trial samples was made by standard method, Georgiev et al. (2007).

Biometric analysis

The biometric analyses of the vegetable crops tomatoes paprika and eggplant, (including a height, a width of the central stem and number of leaves) were made by a standard method (Dimova et al., 2005). The measuring by tomatoes were made at the phase *"forming of two racemes"* and for paprika and eggplants in a phase fifth – sixth leave, before their planting at a permanent place. The data of the morphological investigations were processed mathematically (Shanin, 1977). For comparison of the data from the variants the following coefficients were used.

1. V.C.: $S = \pm\sqrt{\dfrac{\sum (x - x_0)^2}{n-1}}$

Where: S - median quadrature deviation

x_0 – median arithmetical value, n – a number of measurings

$$S\bar{x}\% = \frac{100\,.S\bar{x}}{\bar{x}}$$

2. Index of the exactness of the median arithm. Value:

Sx - Error of the median arithmetical value

$$S\bar{x} = \pm\sqrt{\frac{\sum (x - x_0)^2}{n(n-1)}}$$

By S % < 10% - the variability is insignificantly

10% < S% < 20% - a median variability,

S% > 20% - the variability is significantly

By $S\bar{x}\% = 2$ - high exactness, $S\bar{x}\% = 3$ - median exactness, $S\bar{x}\% \geq 5$ - low exactness.

High exactness means that $\bar{x}$ good enough characterize the general totality.

Results and Discussion

The data for a content of macro- and microelements in the used sapropel sample are shown at Tables 1 and 2. The loss while heated at 1273 K was 199.7 g.kg $^{-1}$ (Table 2), due mainly to a presence of organic matter. The data analysis for macro- and microelements show that their content in the sapropelles was much more, than in the soils and substrates used in seedlings production by vegetable crops. It determine the sapropelles as complex micro- and macro fertilizer.

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 $^{-1}$	,$TiO_{2,}$ g.kg $^{-1}$	$A1_2O_{3,}$ g.kg $^{-1}$	FeO, g.kg $^{-1}$	MпO, g.kg $^{-1}$	MgO, g.kg $^{-1}$	CaO, g.kg $^{-1}$	Na_2O, g.kg $^{-1}$	K_2O, g.kg $^{-1}$	Loss, g.kg $^{-1}$ (1273 K)
Sapropelles	39.76	0.70	11.69	4.57	0.04	2.68	15.46	2.13	1.83	19.97

Table 3
Limited soil hygroscopy (LSH) and pH of the incubated sapropelles manure-soil samples

№	Variant	pH (H_2O) after time		LSH, g.kg $^{-1}$
		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	104.6
4	Control	6.1	6.05	100

The analysis for the results of pH values of the manure-soil mixtures was shown that pH increases to the neutral medium, in dependence of the incubation period and the content of sapropelles. This was the most expressed by the variants with 0.6% sapropel. The change was significant after a month and after two months was insignificant. At the control samples pH varied about 6 (Table 3). It was established too that sapropelles increase the LSH of the trial samples from 11.2 g.kg^{-1} to 46 g.kg^{-1}, in dependence on the sapropel content (Table 3). It is favorable for a normal vegetation of vegetable crops, which at the early growing phase require soils and substrates with good water-physical properties and pH in borders 6.0 – 7.0.

Biometric analyses

The data from the biometric analyses (Table 4) show that by variants I, II, III, the central stem at the tomato plants was more higher, than the control samples from 4% to 22% in dependence of the sapropel amount. With most higher stems are the plants in variety II – 22% according to the control and with 11% according to the median value of the trial. The width of the stems at the variants I and II was 5% more and variety III – 9 % more, than the control (Table 5). The number of leaves was bigger too – from 4% to 20% (Table 6).

There was no difference by the height of the stems at the paprika plants between the variants with sapropelles and the control (Table 7). The V.C. was 37.78, which shows that the variability was significant. The data for the width of the central stem show that most widely are the plants of variety III – with 9% more than the control and 4% more in comparison to the median trial value (Table 8). The V.C for the width of the central stem was 22.3, which shows that the variability was with a median force.

The data from Table 9 show that with biggest

Table 4

Height of the central stem at the tomato plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	V.C.	% to Control	% to the median value
1	Control	18.2	1.68	10.38	100	91
2	I	19	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 5

Width of the central stem at the tomato plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	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 6

Number of leaves at the tomato plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	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	7.1	141	123
4	III	6.2	0.39	7.09	115	100
5	$\overline{X}$	6.2				

Table 7

A height of the central stem at the paprika plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	V.C.	% to the Control	% to the median value
1	Control	16.3	4.67	24.78	100	119
2	I	15.8	6.9	37.78	97	116
3	II	11	2.08	16.36	67	80
4	III	11.6	2.4	17.83	71	85
5	$\overline{X}$	0.28				

number of leaves was the paprika plants from the variety III - 10% according to the control and 5% according to the median trial value. The variability was insignificant - V.C. doesn't surpass 10.78.

Table 8

A width of the central stem at the paprika plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	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	22.3	87	93
4	III	0.26	0.067	22.3	87	93
5	$\overline{X}$	0.28				

Table 9

Number of leaves at the paprika plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	V.C.	% to the Control	% to the median value
1	Control	9.66	0.65	5.9	100	95
2	I	11	1.15	10	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 10

Height of the central stem at the aubergine plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	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	19.4	141	107
3	II	13.5	0.57	3.7	157	119
4	III	11.3	0.65	5.04	131	99
5	$\overline{X}$	11.39				

Table 11

Width of the central stem at the aubergine plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	V.C.	% to Control	% to the median value
1	Control	0.4	0	0	100	93
2	I	0.46	0.067	12.6	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				

The results obtained by the eggplant show that, stems with biggest height have the plants from variety II - 57%, according to the control and 19% according to the median trial value (Table 10). The

Table 12

Number of leaves at the aubergine plants

№	Varieties	Median value	$\frac{2S}{\sqrt{n}}$	V.C.	% to Control	% to the median value
1	Control	5	0	0	100	100
2	I	6	0	0	120	120
3	II	4.33	0.66	13.3	87	87
4	III	4.66	0.66	12.36	93	93
5	$\overline{X}$	4.99				

data at Table 11 show that with the most videly stems are the plants from variety I - 15% was the correlation against the control and 7% against the median trial value.

The number of leaves was biggest by the plants from variety I – 20% was the correlation against the control and 20% against the median trial value (Table 12).

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

A dominating influence upon the growing appearances by the tested plants have the content of microelements in sapropelles, but there's no strict linear dependence sapropel amount into growing indices. The result obtained have shown that sapropelles could be successfully used as a ferlilizer for soils and substrates, poor of micro- and macroelements.

Conclusions

Incubated even in insignificant amount - 0,2%-0,6%, sapropelles stimulate the growth of the stem, as well as the leaves forming. The sapropelles increase the limited soil hygroscopy of soil-manure substrates from 11.2 g.kg^{-1} to 46 g.kg^{-1}.

References

Bmins, T. S., 1994. The Black Sea sapropelle slim. Composition, geneses and perspectives of its using, Dissertation, OMGOR, CNPM, NANU, p. 258 (Ukr).

Dimitrov, P., D. Dimitrov and D. Solakov, 1999. Application of Black Sea bottom sediments for natural ecological fertilizer and recultivation of exhausted soils, Intern. Conf. Geology and Mineralogy Resources of the Black Sea", Kiev, 24-28 November, N.182, p. 418. (Ukr)

Dimitrov, P., N. Simeonova, M. Kamburova, Cv. Moskova, P. Zapryanova, D. Dimitrov and D. Solakov, 2000. Amendment for Soils and Substrates. BG Patent № 63868, p. 3.

Dimitrov, P. and V. Velev, 1988. Opportunities of using of deep-water sapropeloide slimes of Black Sea for agrobiological and industrial purposes. Ocealology, book 17, Sofia, pp. 92-95 **(**Bg).

Dimova, D. and **E. Marinkov,** 2005. Experimental Action with Biometry. *Acad. Publ. Agr. Univ. Plovdiv* , 263 pp. (Bg).

Georgiev, G. **Cv**., 2005. Biological products with grow regulating and pesticide properties. Sofia News, *Bulletin BAS*, № 9825, **vol. III**: 1-2 (Bg).

Georgiev, G., K. Darjonov, S. Dulov, N. Uzunov and A. Ovcharova, 1991. Manual of agriculture land improvement. *Zemia,* Sofia, pp. 7-19 (Bg).

Gorbanov, St., L. Stanchev, Y. Matev, T. Tomov and G. Rachovski, 2005. Agricultural Chemistry. *Publ. Dionis*, Sofia, pp.15-18 (Bg).

Michov, Kr., N. Panayotov, St. Filipov and T. Babrikov, 2001. Manual for vegetable and seed production. *Acad. Publ. Agr. Univ. Plovdiv*, pp.22-28 (Bg).

Shanin, Y., 1977. Methodology of Field Experience. *Acad.Publ.*, BAS, Sofia, pp. 136-146 (Bg).

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