REALIZATION OF DIFFERENT TYPES OF FOLIAR FERTILIZERS BASED ON EXTRACTIONS FROM PEAT

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Abstract. Peat are a recent sediment on bogs, composed in its majority of crop residues with conserved morphological structure generally, but passed through a chemical and physical process whose result is enrichment in humic substances. Humic substances from peat are mineralized very quickly releasing humates and nutritional elements for plants. So, peat is a valuable organic fertilizer used for crop fertilization, especially into horticulture. Recent methods allow the treatment of peat with alkaline solutions for extract, with low-cost, some humic acids and nutrients that they contain. These extracts sprayed on the plants at a rate of 5-10 l/ha by 2-3 applications during the season growing provide important yield increases.

Keywords: peat, humates, nutritional elements

Introduction

Scientific progress in increasing awareness of the role of humic substances in the development of soil fertility and reducing negative effects on the quality and quantity of humus in the cultivated soils, including those intensively chemically fertilized, stimulated the scientific research concern in various countries for creating new types of humic fertilizers that ensure optimum nutritive satisfaction and amelioration of soil humus (Dorneanu A. şi col. 2007).

A main category of raw materials for the production of humic fertilizers at the industrial quantities in our Romania is the peat that is widespread in various humid places especially in hilly and mountainous areas.

It is estimated a peat volume available for the production of humic fertilizer over 80 million m^3 (Pop E., 1960 Davidescu et al., 1969).

Academician Emil Pop in his monumental work „Peat swamps in Romania", in 1960, defined the peat as being a recent sediment mostly composed from vegetal residues maintaining, in general, conserved the morphological structure of plant residues, but passed through a physical and chemical process (process of peat formation) whose main result is a relative enrichment in carbon.

There are two categories of peat important for the production of fertilizers: eutrophic and oligotrophic.

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Eutrophic peats are formed under growing vegetation in a water saturated substrate, rich in minerals derived from leaching water under the anaerobiosis conditions of soil and water. Peat layer is formed under the infiltrated water (Pop E., 1960).

Floristic composition consists mostly of genus of *Phragmites, Typha, Scirpus, Juncus, Carex* and numerous other aquatic species with lower attendance. The appearance of the vegetation is very different, sometimes prevails reed, sometimes sedge, wet meadow or a marsh with brushes. Due to the floristic composition and concentration of infiltrated salt water, eutrophic peats have a humic and mineral composition very different. They contain organic substances in a proportion of 64-87%, 10-21% ash, they have a specific gravity of 1.6-1.8 g/cm^3, a calorific value of 1300-2000 kcal/kg. The water content is of 70-75% (Petrescu I. et al. 1986-1987).

This peat is used for the production of fertilizers in the form of mixtures with strong mineral nutrients, or for the extraction of humic acids with potassium hydroxide, sodium hydroxide or ammonium hydroxide. These acids are used to produce different types of foliar or root complex liquid fertilizers mixed with mineral nutrient solutions (Dorneanu A. şi col. 2011).

Oligotrophic peats are formed in cold climates rich in precipitation in the Northern Hemisphere, including Northern Europe (including northern Romania) on soils poor in mineral elements (crystalline schist, sandstone, sandy alluvial deposits). The eutrophic swamp (***tinov***) may occur by direct silting of the oligotrophic lake, from a eutrophic swamp passing through a mesotrophic stage or a peaty forest (Pop E., 1960).

Flora is composed of several species of sphagnum moss and slow-growing oligotrophic phanerogamae (Pop E., 1960). Due to the strong mineral sphagnum moss development, the contact with the mineral substrate is highly reduced or discontinued, the only one nutritional source for development being represented by the elementary particles over moorland by winds and rich rainfalls.

Due to the natural development conditions, oligotrophic peats have a more uniform composition than the eutrophic peats, being the same composition everywhere. They have a high content of organic matter (2-98%), very low content of mineral elements (2.3-2.5%) measured in ash, specific gravity of 1.6 g/cm^3 and thermal power from 2200 to 2570 kcal/kg. The peats of such a composition can be used very effectively for extracting the humic acids to produce liquid humic complex fertilizers with mixture mineral nutrients (Dorneanu A. şi col. 2010).

Materials and methods

Considering the quality of oligotrophic peat for producing humic acids for obtaining various types of foliar complex fertilizers by their mixture with mineral nutrients, the oligotrophic peat from the Poiana Mare enterprise, Suceava County, was used.

The dry matter composition of this peat was: organic matter (OM) - 68.0%, total nitrogen (t_N) - 0.158%, phosphorus (P_2O_5) - 0.0023% and potassium (K_2O) - 0.0265%, pH being 4.58. (Dorneanu A. şi col. 2013)

Results and discussion

Table 1 shows the compositions of manufactured fertilizers. The content of phosphorous, potassium, magnesium and humic acids is the same in all the types. Differences are only with the nitrogen contents.

The f F-111 and TH5 Bs fertilizers also differ by the addition of the ASFAC-BCO-4an auxine stimulator for plant growth. This bio-stimulator stimulates cell division and increase in cell volume (DORNEANU A. et al., 2013).

All the other 5 fertilizers have been tested in order to differentiate the yield increases versus non-fertilized treatments with different soil types in different climatic zones.

Table 1. Compositions of F-111 TH3, F-111 TH5, F-111 TH10 and F-111 TH5 Bs foliar fertilisers constituted from mixture of humic acids with minerals nutrients (Dorneanu A. şi col. 2013).

Item	Components of fertilisers	MU	Fertiliser types			
			F-111 TH3	F-111 TH5	F-111 TH10	F-111 TH5Bs
1.	**Total nitrogen (Tn)**	**%**	15,5	18,5	20,5	18,5
2.	**Phosphorus (P_2O_5)**	**%**	7,6	7,6	7,6	7,6
3.	**Potassium (K_2O)**	**%**	8,9	8,9	8,9	8,9
4.	**Magnesium (Mg)**	**%**	0,15	0,15	0,15	0,15
5.	**Humic acids**	**%**	3,81	3,81	3,81	3,81
6.	**ASFAC –BCO4 growing bio-stimulators**	**%**	-	-	-	-

The foliar fertiliser application technology of consisted from three applications during the growing season with a fertiliser solution of 1% in a volume of 500 l/ha solution per treatment.

The obtained results are as follows:

3. Maize grown on Cambic Chernozem receiving a total of 15 l/ha fertilizer reached yield increases between 2327 and 2538 kg kernels/ha, respectively 141.0 - 145.6 f % as compared to the control (Table 2).

4. Potatoes grown on Cambic Chernozem and receiving the same rates obtained increases between 9502 and 9847 kg tubers/ha, respectively 145.7 - 147.4% as compared to the control (Table 3).

5. Tomatoes grown on Argic Phaeozem soil and receiving the same rates obtained increases between 2190 and 3160 kg/ha fruits, respectively 110.4 - 115.0 % as compared to the control (Table 4).

6. Mountain natural grassland on Eutric Cambic soil 2 two applications totalizing 10 l/ha fertilizer of the same types obtained increases ranging between 1560 - 2123 kg dry hay/ha, respectively 122.8 - 132.6% as compared to the control (Table 5).

Table 2. Efficiency of F-111 TH3, F-111 TH5, F-111 TH10 fertilizers applied to the DK 315 maize hybrid grown on Cambic Chernozem at the ICB Iaşi, experiment field of the USAMV Iaşi (Bireescu şi col., 2012).

Nr. Var.	Treat-ment	Nr. treat.	Solution concentration %	Quantity of applied fertiliser l (kg)/ha		Kernel production kg/ha	Increase	
				For one application	For all the applications		Kg/ha	%
1.	Non-fertilized control	-	-	-	-	5563	-	100,0
2.	F-111 TH3	3	1.0	5.0	15.0	7890	2327	141.8
3.	F-111 TH5	3	1.0	5.0	15.0	7987	2427	143.5
4.	F-111 TH10	3	1.0	5.0	15.0	8102	2538	145.6
LSD 5%						714		
LSD 1%						1256		
LSD 0.1%						1565		

*Without basic soil fertilization

Table 3. Efficiency of F-111 TH3, F-111 TH5, F-111 TH10 fertilizers applied to the potatoes Sante cultivar grown on Cambic Chernozem at the ICB Iaşi, experiment field of the USAMV Iaşi (Bireescu şi col., 2012).

Nr. Var.	Treatment	Nr. treat.	Solution concentration %	Quantity of applied fertilizer l (kg)/ha		Yield of potatoes l (kg)/ha	Increase	
				For one application	For all the applications		Kg/ha	%
1.	Non-fertilized control	-	-	-	-	20789	-	100,0
2.	F-111 TH3	3	1.0	5.0	15.0	30385	9596	146.2
3.	F-111 TH5	3	1.0	5.0	15.0	30291	9502	145.7
4.	F-111 TH10	3	1.0	5.0	15.0	30636	9847	147.4
LSD 5%						3086		
LSD 1%						4793		
LSD 0,1%						6121		

*Without basic soil fertilization

Table 4. Efficiency of F-111 TH5, F-111 TH5 Bs**, F-111 TH10 fertilizers applied to tomatoes Romec cultivar grown on Agric Phaeozem at the USAMV Cluj-Napoca, Iernut experiment field (Dorneanu A. şi col. 2012).

Treatment	Nr. treat.	Solution concentration %	Quantity of applied fertilizer l (kg)/ha For one application	Yield Of potatoes l (kg)/ha		Fruit increase	Increase	
				For one application	For all the applications	Kg/ha	Kg/ha	%
1.	Non-fertilized control	-	-	-	-	21060	-	100,0
2.	F-111 TH5	3	1.0	5.0	10.0	23250	2190	110.4
3.	F-111 TH5 Bs	3	1.0	5.0	10.0	23840	2780	113.2
4.	F-111 TH10	3	1.0	5.0	10.0	24220	3160	115.0
LSD 5%						560		
LSD 1%						780		
LSD 0,1%						1060		

*) Basic soil fertilization with N-80, P_2O_5-80, K_2O-80 Kg/ha

**) Bs = ASFAC –BCO-4 auxinic bio-stimulator

Table 5. Efficiency of F-111 TH3, F-111 TH5, F-111 TH10 fertilizers applied to grassland on mountainous Eutricambosol at the Research- Development Institute for Land grasses - Braşov, Drăguş experiment field, Făgăraş Depression (Dorneanu A. şi col. 2012).

Nr. of treatment	Treatment	Nr. of treatment	Solution concentration %	Quantity of applied fertilizer l (kg)/ha		Hay yield d.m. kg/ha	Increase	
				For one application	For all the applications		Kg/ha	%
1.	Non-fertilized control	-	-	-	-	6830	-	100,0
2.	F-111 TH5	2	1,0	5,0	10,0	8390	1560	122,8
3.	F-111 TH5 Bs	2	1,0	5,0	10,0	8410	1580	123,1
4.	F-111 TH10	2	1,0	5,0	10,0	9060	2230	132,6
LSD 5%						1580		
LSD 1%						2130		
LSD 0.1%						2840		

*) Basic soil fertilization with N-50, P_2O_5-50, K_2O-50 Kg/ha

Among the results, the followings are observed:
- all the 4 fertilizers applied at relatively low rates provided significant yield increases which show high efficacy;
- yield increases with all the crops in different climatic zones proved their universal character suitable to be applied for various crops and plant species.

Conclusions

The performed experiences lead to the following conclusions:

1. the complex liquid foliar fertilizers with humic acids from peat represent a new category of fertilizers ensuring a fertilization level under the ecological protection conditions;
2. offers a wide possibility for applying fertilizers in several stages during the growing season (from the occurrence of the first leaf up to the beginning of fructification) by spraying (pulverization) the plant foliage at low amounts on the order of liters or tens of liters per hectare which are assimilated almost completely preventing soil pollution;
3. the nutritive elements incorporated in humic fertilizers are very available for plants. Ions and molecules in these fertilizers are immediately absorbed through the leaves and are metabolized in physiologically active organic compounds that integrate in the general metabolic process causing the intensification of plant growth and development. Foliar uptake rate is much higher than that through the roots (Dorneanu A. şi col. 2009).
4. the costs of peats are low and their processing is possible in simple installations with low investment costs both in the farms and small industrial units with the lowest cost of foliar fertilizers;
5. they are available to contain macro and micronutrients, often also additions of growing stimulators can allow the achievement of a large number of fertilizer types that facilitate differentiated fertilizations with minimal costs and maximum efficiency;
6. the peat reserves in Romania,, estimated at over 80 mil. m^3 are spread over large hilly and mountainous areas and ensure the necessary raw material without depletion limits for a long period of this resource.

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