PRELIMINARY RESEARCH IN OBTAINING FOLIAR CONCENTRATED SEMIECOLOGICAL FERTILISERS

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ABSTRACT

In this paper we present the main aspects of a preliminary laboratory research in obtaining foliar concentrated fertilizers based on macro elements (N, P, K), microelements (Ca, Mg, Cu, Zn, Fe, Mn, B, Co, S) and natural plant extract. The first part of the paper describes the need of replacing traditional chemical fertilizers with foliar ones by showing the disadvantages in using the first ones and advantages in using the second ones. Then we review the modalities of extraction of the active principles from some plants, which are part of the spontaneous native flora (macerated, extraction with the Soxhlet device and extraction through refluxing), done in the laboratory, in the perspective of obtaining maximum extraction yields with various solvents or solvent mixtures.

In the following part we present a few receipts receipts for obtaining semi ecological foliar fertilizers through conditioning of the macro elements, microelements and of the natural plant extract.

The final part of the paper is dedicated to laboratory research regarding the testing of variants crops (maize, sunflower and Soya), and presenting in the end the conclusions which come off from this study.

Keywords: *foliar fertilizer, natural plant extract*

1. INTRODUCTION

Taking into consideration the fact that plants can procure the necessary nutritive substances through their root, and leaves, too, it is possible to use the manure by spreading on the surface of the soil or integrating in the soil (NH_3 anhydrous), but also foliar, by sprinkling the leaves with a diluted solution in order to avoid burning these. [1]

Beside the classical fertiliser (N, P, K), in the last 20 years, it also has been used successfully some fertilisers which contain microelements (Mn, Mg, K, Na, Ca, Co etc) mixed with traditional fertilisers. This type of fertiliser provides the nutritive contribution of macro and micro elements necessary for a plant, promoting to the harmonious development of the plant and increasing its resistance to the stress factors (drought, diseases,

pests, etc). The disadvantage of using the classical fertiliser is that the root does not absorb a big quantity, because it is spread on the surface of the soil. [2] That's way it is accumulated in the soil and it can affect the phreatic water network from that area. Using classical fertilisers provides additional productions per hectare, but the costs are high enough (about 2.000.000 lei/ha).

In the last 10 years, there have been rapid growths of the foliar fertilisers, which contain macro-elements and microelements, and natural extracts that have a role as bio-stimulators. They are spread on the leaves; these are the most adequate "gate" of the bio-stimulators to the plant (the absorption is about 20 times higher through leaves than roots). On contrary, macro and microelements are better absorbed through roots. [3] The advantage of the foliar fertiliser of this type is that it determines important growth of production (20-30%) by using some relative small amounts (1-4 l/ha), at real lower prices than the classical ones (about 400.000 lei/ha).

The foliar fertilisers provide usually, the following:

- the complementary feeding of the plant with microelements, vitamins, amino acid, enzymes, etc;
- a higher resistance at diseases, insects, drought and cold:
- the absorption of the nutritive substances, through leaves, which is faster than the one through soil, through leaves;
- an increased crop up to 50% [4].

As a result of these elements, in the experimental section of this preliminary lab study, we aimed to obtain some alcoholic extracts from three plants (coriander – *Coriandrum nativum*, horsetail – *Equisetum,* stinging nettle – *Urtica dioica*), using usual techniques of extraction. In the end, we prepared a variant of the semi-ecological foliar fertiliser made by macroelements (N, P, and K), microelements (B, Na, Ca, Co, Mg, Fe, Cu, S, Mn, and Zn) and natural extracts from the plant obtained before.

2. METHODS AND MATERILAS

The obtaining of the natural extracts from plants is the first and the most important step of our experimental research. For obtaining these we used three plants belonging to the spontaneous native flora: coriander – *Coriandrum nativum* (crushed seeds), stinging nettle – *Urtica dioica* (dry, chopped leaves and stems) and horsetail – *Equisetum* (dry, chopped leaves and stems). We also used ethylic alcohol with a concentration of 94-96%, watery solution of ammonia with a concentration of 24-25%, calcic chloride solution with a concentration of 50% and demineralised water.

We used three different types of extraction (using the Soxhlet equipment, by normal refluxing and maceration), for each of them it was necessary o different type of equipment:

a) The Soxhlet equipment which is equipped with a siphoning pipe used as superabundance, a lateral pipe which makes the

connection to the distillation balloon and a refrigerator attached on the top side of the pipe where it is inserted a cardboard bullet.

b) The normal refluxing equipment made by a hitting source, an ascending refrigerator and a balloon with round bottom.

c) The balloon with dusty bottom and stoppers which provide a tight closing for the maceration process.

The contribution of the macro and micro-elements for obtaining the foliar fertiliser was done by using some salts (halogens, sulphides, nitrogenous, phosphates etc) and other inorganic compounds (oxides, sulphides etc). The treatment of the foliar fertiliser was made in the second step of the experimental research.

3. RESULTS AND ANALYSES

The variants of the natural extracts from plants, which we made in the laboratory are presented in Table 1.

Table 1. *The variants of the natural plants extracts*

Variant	Raw material	Unit of measure	Values	Extraction condition
1	Coriander (*Coriandrum nativum)* Ethylic alcohol 96% Ammonia 25% Calcium chloride solution 50% Demineralised water	Grams Millilitres Millilitres Millilitres Millilitres	22.5 195 1.2 12 31.5	Extraction made using the Soxhlet device at 78^0 C, for 5 hours
2	Coriander (Coriandrum nativum) Horsetail (*Equisetum)* Stinging nettle *(Urtica dioica)* Ethyl alcohol 96% Calcium chloride solution 50% Demineralised water	Grams Grams Grams Millilitres Millilitres Millilitres	15 3 2 100 5 38	Extraction made using the Soxhlet device at 78^0C, for 3 hours
3	Coriander (Coriandrum nativum) Horsetail (*Equisetum)* Stinging nettle *(Urtica dioica)* Ethyl alcohol 96% Calcium chloride solution 50% Demineralised water	Grams Grams Grams Millilitres Millilitres Millilitres	7.5 1.5 1 38 2.5 9	Extraction made using normal refluxing at 78^0 C, for 3 hours
4	Coriander (Coriandrum nativum) Horsetail (*Equisetum)* Stinging nettle *(Urtica dioica)* Ethyl alcohol 96% Calcium chloride solution 50% Demineralised water	Grams Grams Grams Millilitres Millilitres Millilitres	7.5 3 1 38 2.5 9	Extraction made using normal refluxing at 78^0C, for 90 minutes
5	Coriander (Coriandrum nativum) Horsetail (*Equisetum)* Stinging nettle *(Urtica dioica)* Ethyl alcohol 96% Calcium chloride solution 50% Demineralised water	Grams Grams Grams Millilitres Millilitres Millilitres	3.75 0.75 0.50 19 1.25 6	Extraction made using maceration for 4 days at the room's temperature
6	Coriander (Coriandrum nativum) Horsetail (*Equisetum)* Stinging nettle *(Urtica dioica)* Ethyl alcohol 96% Calcium chloride solution 50% Demineralised water	Grams Grams Grams Millilitres Millilitres Millilitres	3.75 0.75 0.50 19 1.25 9	Extraction made using maceration for 7 days at the room's temperature

In the experimental research we aimed to extract as many as possible active principles from those plants. As a result the maceration provides the extraction of vitamins and enzymes which have deteriorated by boiling. By refluxing at low periods of time, (less than 3 hours), there are extracted active principles which have medium molecular mass, which are soluble at warm temperature in water and ethyl alcohol solution. Using the Soxhlet device there are extracted almost all the rage of the active principles (even with big molecular mass and less soluble in water) in short periods of time (less than 5 hours).

We have to avoid long refluxing, because it produces partial deterioration of the active principles. Also, a long maceration (more than 5-6 days) can lead to the putrefaction process of the mixture of plants, water and ethyl alcohol.

The natural extracts obtained have different pH and density, according to the type of equipment used, the period of time for extraction and the solvents mixture. The dry substance percent varies in the same way, as we can notice from Table 2.

***Table 2**. The characteristics of the natural plants extracts*

Variant	Density(g/cm^3)	pH	Dry substance content (%)
1	0.893	8.60	5.78
2	0.935	5.00	3.62
3	0.985	5060	11.54
4	0.924	6.01	9.12
5	0.896	6.05	6.13
6	0.921	6.43	6.54

All the variants of extracts have a green-brown colour.

In the second part of our experimental research we succeeded the conditioning of the foliar fertiliser which contains macro and micro-elements and natural extracts from plants.

The structure of the foliar fertiliser obtained is presented in table 3.

***Table 3.** The structure of the foliar fertiliser obtained in laboratory.*

	Macro-elements			Micro-elements									Natural extract	
	N	P	K	Fe	Cu	Mn	B	Zn	Co	S	Ca	Mg	Variant 4	Variant5
Structure (g/l)	95	60	30	1.4	4.1	0.8	1.6	1.5	1.7	4.0	1.0	1.8	200	200

The conditioning was realised by a strong mixture for about 90 seconds with a mixer 1000 rotations /minute. The demineralised water which has a role of a solvent is part of the structure of the foliar fertiliser.

The characteristics of the foliar fertiliser are presented in table 4.

Table 4. *The characteristics of the foliar fertiliser produced in the laboratory*

No	Characteristic	Unit of measure	Value
1	Looks	-	Clean green-brown liquid,
2	pH	-	6.25
3	Density at 20^{o} C	g/cm^3	1.08
4	Dry substance content	%	17

Referring to the composition of the foliar fertiliser, we can say that the role of each component is very important. So the macro elements (N, P, K) are essential nutritive elements which provides the growth and development of the plants. On the other hand, the effects of the micro-elements are so divers, such as:

- Calcium helps the growth of the cells;
- Magnesium helps the germination of the seeds and production of sugar;
- Copper as an enzymes activator is part of the B, C and P vitamins, supporting the producing of sugar and starch;
- Iron has a role in producing chlorophyll, fixing the nitrogen, in the good working of enzymes and plants' breathing;
- Manganese which is an enzyme's component helps in the breathing process and producing chlorophyll, an also in increasing the resistance at drought;
- Boron has a role in stimulating the enzymatic activity, creating the reproduction organs of the plans and producing seeds;
- Cobalt activates the enzymes, intensifies the photosynthesis and increases the quantity of starch;
- Sulphur has a role in forming the chlorophyll.

The resulted foliar fertiliser produced in the laboratory was tested in the greenhouse on maize crops, sunflowers, and Soya, as a solution (0.20 - 0.40l concentrate fertiliser in 30 litres of water).

In table 5 there is presented the technical conditions of using and the profit obtained.

Table 5*. Technical conditions of using the obtained product*

No	Crop	Numbers of sprinkling	Quantity/ sprinkling (l/ha)	Way of application	Profits
1	Maize	2	0.2 l solution in 30 l water	3-4 leaves and 9-12 days after the first sprinkling	30-45 %
2	Sun-flower	2	0.24 l solution in 30 l water	4-5 leaves and 11-13 days after the first sprinkling	10-15 %
3	Soya beans	2	0.22 l solution in 30 l water	4-5 leaves and 12-14 days after the first sprinkling	25-30 %

As we can notice from the table above, following the technology of application of the product it was obtained an important profit that proves that this preliminary laboratory research confirms our expectations referring to the efficiency of this type of foliar fertiliser. It is a half-

ecological one because it contains an ecological part (the natural plants extract) and also macro and micro-elements (some of them having a noxious action in big concentrations).

4. CONCLUSIONS

As a result of the experimental research, we can draw the following conclusions referring to the semi-ecological foliar fertiliser based on natural plants extracts:

- The semi-ecological fertiliser is sprinkled on leaves, which are the most appropriate way for the bio-stimulators in a plant;
- It contains all the necessary components for developing macro elements (N, P, K), micro-elements (Ca, Mg, Zn, Cu, Fe, Mn, B, Co, S) and natural plants extracts as a bio-stimulator;
- Macro-elements are essential nutritive components which provide the growth and the development of the plant;
- Micro-elements have an important role in the development of the cells, seeds germination, as an enzymes activator, producing chlorophyll and increasing the resistance at drought;
- The natural plants extract contains enzymes, vitamins, amino-acids, proteins, and starch which have an important role in intensifying the cell division, ions transfer through the cellular membrane, providing a high rate of absorption of the nutritive elements by plants, and the increase of the natural resistance of the plant at insects and fungus;
- It provides important benefits (10-45%) with a low cost.

5. REFERENCES

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