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Research regarding the soluble salts regime for field cultivated tomatoes, whit extraradicular fertilization (field culture and greenhouse culture comparative studies)

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Abstract The studies we did on a faeoziom argic type of soil and on tomatoes cultivated greenhouse soil, proved that that there is no excessive accumulation of soluble salts under the administration of large quantities of organic and mineral fertilizers (simple and complex), the extraradicular fertilization being a means of prevention and limitation of such accumulation.

Key words

soluble salts, areas of risk, optimal agrochemical foliar fertilization, faeoziom argic soil, greenhouse soil, tomatoes

Saline soils are characterized by a high content of soluble salts. Fertilizers influence osmotic pressure (the salinity) in a manner specific to each ion and depending on the used amount. Knowing the effect of fertilizers on the osmotic pressure, we can avoid mistakes in the application of doses that produce a nutritional imbalance degrading nutrition.

Plants have also different tolerance to salinity, the tomatoes are a species with mild tolerance. (3, 8, 10)

In terms of tolerance to salinity, it is known that tomatoes do not support concentrations above 0.17% in light soils, over 0.20% in mild soils and over 0.25% in compact soils. (2)

Greenhouse soils are subject to frequent salinisation and alcanization due to accumulation of soluble salts from organic manure and chemical fertilization, irrigation water, groundwater and water from the chemical alteration of the soil mineral fraction.(7, 9)

In order for the greenhouse soil to meet the agrochemical requirements, the total content of soluble salts must be adjusted, and we must establish a good system of soil fertility.(6)

Regarding the optimization of the soil content in its nutrient elements, we must be ensured that after fertilization, the concentrations of the nutrient ions must be directed towards the optimal sufficiency levels in soils.

The fertilizer quantities to be administered to the tomato crops, should be linked with the culture system.

Thus, the large amounts of fertilizer is given to the greenhouse culture, compared to that of the solars or field, due to higher production potential, abundant watering and different values of climatic factors (temperature and humidity).

The specific nutrients consumption for the two culture systems (in the opinion on several authors, quoted by (1, 4, 7), is presented in Table 1.

Due to a specific high consumption of tomatoes, it is necessary to establish proper fertilization programs, involving the use of organic and mineral fertilizers, applied to both soil and plants (foliar fertilization) related to culture conditions and planned production.

Table 1

Specific nutrients consumption in field and greenhouse tomatoes

Culture	Production t/ha	Specific consumption (kg per ton of commercial product)					Author
		N	P_2O_5	K_2O	CaO	MgO	
Field tomatoes	40	2,75	0,6	3,7	3,3	-	ANSTETT, 1968
	35	3,14	1,1	4,0	4,0	-	HÖSSLIN şi col., 1964
	40	2,8	0,8	4,0	-	0,50	KRUG, 1986
Greenhouse tomatoes	150	3,8	0,60	7,7	-	-	ANSTETT, 1986
	80	3,1	0,64	3,4	-	0,63	GHIDIA şi col., 1980
	100	3,2	0,9	6,3	5,3	0,86	GEISSLER şi col., 1979
	100	3,8	0,30	5,2	-	-	DAVIDESCU D. şi DAVIDESCU VELICICA, 1992

Material and Methods

For the field crops, we used the "Unirea" type.

The field crop was established on a argic faeozoim soil in Oradea, that present a good native fertility, determined primarily by high cation exchange capacity and a good representation of adsorption complex components: low-alkaline reaction (pH 7.5 to 7,7), organic matter from 6.0 to 7.56% humuficabilă, I_N 5,88- 7,40, P mobil 320- 370 ppm, K mobil 338-450 ppm.

The applied technology was to by the specialized recommended literature for a field tomato crop.

The types of foliar fertilizers were applied to an agrochemical fund resulting from the interaction of organic fertilization (50t/ha manure) using complex mineral fertilizers (N_{120} P_{120} K_{120}).

The experimental protocol includes a range of foliar fertilizers on organo-mineral fertilization presented above (table 2).

Table 2

The foliar fertilizers assortment applied to field cultivated tomatoes at Oradea

No. var.	Foliar assortment*	Solution concentration%
1	Water sprinkled whitness	-
2	Nutrifag	1%
3	Bionutrifag F	1%
4	Ferticare 24-8-16	1%
5	Polyfeed 19-19-19	1%

* three treatments: first treatment at the first blossom, the other with a 14 days delay.

The greenhouse experiments were conducted in the University of Agriculture Sciences and Veterinary Medicine Cluj-Napoca. We used F1 hybrid Cronos for the experiments.

The experiment involved the application of foliar fertilizers on tomatoes grown in agrochemical conditions of a "greenhouse soil", optimized from components of fermented manure (20%), acid peat (50%), ground celery (25%) and sand (5%).

The greenhouse soil has favorable agrochemical indicators for an intensive tomato culture, due to its constituents and also to the fertilization program, specific to such a system: neutral-weak alkaline reaction (pH 7.2 to 7.4), very good representation of humifiable organic matter (MO

humifiable 7.02 to 7.76%), large accumulation of nitrogen (I_N 6,87- 7,64), average accumulation of phosphorus (P mobile 70-98 ppm) and high mobile potassium (K mobil 386-420 ppm).

With respect to physical properties, the greenhouse soil has relatively favorable indicators – a seemingly normal density and good porosity (D.a. 1,18 g/ m^3, P.t. 65%). These indicators may be appropriate to some technological activities suitable for the greenhouses cultivated tomatoes.

The technology we applied to the culture, was that recommended by the specialized literature for the greenhouses cultivated tomatoes.

The experimental protocol includes a range of foliar fertilizers, having an organo-mineral fertilization, specific to the tomato crop (table 3).

Table 3

The foliar fertilizers assortment applied to greenhouse cultivated tomatoes University of Agriculture Sciences and Veterinary Medicine Cluj-Napoca

No. var.	Foliar assortment	Solution concentration %
1	Water sprinkled whitness	-
2	Folplant 231	1%
3	Ferticare 14-11-25	1%
4	Ferticare 24-8-16	1%
5	Polyfeed 19-19-19	1%

Foliar fertilization was done in the morning, by fine sprinkling on plants. Three foliar treatments were applied: the first one, at the appearance of first blossom, and the next two treatments, every 14 days.

For he analytical approach of the soil samples, we used the following methodology:

- the pH was determined in aqueous suspension, 1:2,5 soil-solution proportion; using the potentiometric method, with a couple of electrodes bottle-calomel;
- the humus was determined by wet oxidation and titrimetric solution (after Walkley-Black, cocoon alteration);
- the N_t was determined by using the Kjeldahl method;
- P-mobil (accessible) was determined by using the Egner-Riehm-Domingo method (P-AL), colorimetric, in extraction with ammonium lacto-acetate;

Results and Discussions

The applying of fertilizers in field and greenhouse tomato culture is done using an intensive "conventional system", the species and the soil having a known and recognized interaction of organic fertilizers, simillar to that of the simple and complex mineral.

The experimental protocol on the application of foliar fertilizers, has considered the use of such fertilizing resources, especially in the agrochemical soil optimization, as an essential factor in the growth of the foliar compositions effect. Thus, foliar fertilizer application options are uses as models in an "integrated system" of fertilization.

Although the type of mold in field grown tomatoes have not agrochemical indicators suggesting the possibility of secondary salinization or excessive accumulation of salts, however, high doses of fertilizers applied to soil (organic, mineral simple and complex) have recommended a rigorous analytical control over the content of soluble salts (expressed as mineral residuum g/100g of soil) (table 4).

Table 4

The concentration of soluble salts (mineral residuum g/100g of soil) in greenhousesoil cultivated with tomatoes

No. var.	Applied foliar assortment	pH_{H2O}	Mineral residuum g/100g of soil	Tomato salinity tolerance*	
				Affected production extent	50% decrease of production extent
1	Water sprinkled whitness	7,7	0,14	0,2	0,45
2	Nutrifag	7,6	0,13		
3	Bionutrifag F	7,6	0,12		
4	Ferticare 24-8-16	7,6	0,13		
5	Polyfeed 19-19-19	7,5	0,11		

* Average data, from Bernstein, quoted by Hera and Borlan, 1980

It appears that the net concentration of soluble salts is not a limiting factor for field tomato production, on the Oradea chernozem, and the foliar fertilization enables the consumption and translocation level of nutrient in plants.

The extraradicular application of fertilizers can be a means of prevention and limiting of the accumulation of soluble salts in vegetable soils, benefiting from various assortments of fertilizer that are applied in intensive doses (high and very high).

Despite having applied large amounts of fertilizers for the greenhouse cultivated tomatoes, we had no negative effects related to increased salinisation and concentration of soluble salts, and also, compared to the field culture soil. (Table 5).

Table 5

The concentration of soluble salts (mineral residuum g/100g of soil) in greenhouse soil cultivated with tomatoes

No. Var.	Applied foliar assortment	pH_{H2O}	Mineral residuum g/100g of soil	Tomato salinity tolerance*	
				Affected production extent	50% decrease of production extent
1	Water sprinkled whitness	7,2	0,13	0,20	0,45
2	Folplant 231	7,4	0,12		
3	Ferticare 14-11-25	7,2	0,13		
4	Ferticare 24-8-16	7,3	0,13		
5	Polyfeed 19-19-19	7,3	0,11		

* Average data, from Bernstein, quoted by Hera and Borlan, 1980

We can say, without reservation, that the salts accumulated in greenhouse soils does not prejudice, at this stage, the production of tomatoes and we can not forecast yet, the phenomena of secondary salinisation.

Conclusions

1. Although the cultures we studied received additional organo-mineral fertilization applied to soil and plants, soil analysis did not reveal secondary salinization phenomena, soluble salt content being between the agrochemical optimum limits.
2. The level of soluble salts concentration is not a limiting factor to the tomato culture on such soils, and the production is affected in a negative way.
3. Foliar fertilization are justified due to the high specific consumption of tomatoes correlated with planned production, being considered as an "integrated" and complementary measure.

4. Extraradiculare fertilization results in a higher emission of protons (H+ ions) at the root level, favoring ionic exchange and a more active nutrition, so as the bioavailability and translocation of nutrients from the soil changes to positive.
5. In this respect, foliar fertilization may be a means of preventing and limiting the accumulation of soluble salts in soils receiving high and extremely high amounts of fertilization, using organo-mineral fertilizers.

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