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NUTRITIONAL STATE OF ECOLOGICAL VEGETABLES IN DROUGHT CONDITIONS

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Keywords: nutritional state, ecological vegetables, leaves cellular sap pH

Abstract. The contents of mineral nutritional elements in vegetables' leaves were studied in an ecologically assessed field at the Research-Development Station for Vegetables (SCDL) Bacău, on a Fluvisol, in 2006 and 2007. Soil texture is sandy-loamy, pH 6.2-6.8, and the humus content 2.4-2.6%. Vegetables have been grown here for several tens of years. In the last years, in an ecological agriculture system, the soil has been fertilized only with farm-made compost and green manure. Organic fertilization didn't significantly improve the nutritive elements soil contents but it had the merit to preserve the soil fertility properties, along with the natural equilibrium between nutritional elements. Under these conditions, lower total nitrogen contents were determined in tomato leaves and higher in egg-plant leaves. Phosphorus contents proved to be relatively constant with egg-plants and a little lower with tomatoes; potassium and calcium contents were much lower with tomatoes; zinc and copper contents registered depletions, both for egg-plants and tomatoes, the iron contents slightly increased, while manganese contents remained relatively constant. In 2007 the potassium contents in tomatoes leaves shifted towards the critical domain, as compared to the lower limit of the excessive domain in 2006, in egg-plants leaves it remained under this domain limit, as in 2006; the calcium contents remained in the excessive domain, as in 2006, the magnesium contents shifted towards the critical domain, as compared to the normal one in 2006, iron contents remained excessive for tomatoes; the zinc remained in the normal content domain for tomatoes, as in 2006, and decreased to the critical domain for egg-plants; the copper remained in the excessive content domain, but at the inferior limit of it, unlike in 2006. Due to these modifications of ratios between the mineral nutritional elements absorbed in leaves in 2007 the cellular sap pH values were lower than in 2006.

Introduction

The Research-Development Station for Vegetables Bacău was founded on September 1st 1974. It lies in the Eastern part of the Bacău municipality, in the waterside and first terrace of the Siret River, at 91 m altitude. The soil type is

Fluvisol[13], with a sandy-loamy texture, pH 6.2-6.8 and a humus content of 2.4-2.6%. The multi-annual average temperature is 8.9ºC. The total rainfall amount is relatively low, 550 mm (http://www.artelecom.net/legumebac/).

The Station grows vegetables on fields ecologically assessed for more than 15 years. A number of ecological agriculture experiments also take place here. One such experiment studies the effect of organic fertilization as part of a project which aims to optimize the nutritional elements flow in a soil-plant system when growing ecological vegetables. The fact was observed that, as compared to 2006, in 2007 the plant growth was strongly influence by drought: the plants withered, the yields were low, and the fruits didn't develop normally. That's why the vegetables nutritional status was studied, as described by the foliar analysis, as compared to the precedent year.

1. Material and Method

The parcels of the studied experimental field were exclusively organically fertilized, with green manure (wheat), with compost (20 t/ha) or without. The long-term exclusively organic fertilization doesn't significantly increase the nutritional elements contents of the soil, but has the merit to maintain its fertility properties, along with the natural equilibrium between the nutritional elements. The yields are lower than those obtained by mineral fertilization and with a less uniform aspect; they address a certain consumer's category (Lungu et al., 2007).

Foliar analysis and leaves cellular sap pH determinations were carried on in 2006 for six tomato samples and two egg-plant samples, and in 2007 for four tomato samples and two egg-plant samples. Minimum, maximum and average values were computed for the mineral elements contents, as well as minimum, maximum and median values for the pH determinations.

2. Results and Discussions

The general tendency in 2007 as compared to 2006 is that of decrease of the mineral elements contents in the analyzed vegetables leaves, without always entering a lower content class. Thus, the nitrogen contents remain in the same value interval for tomatoes, better grouped around the average value (Figure 1), in and a bit above the normal content domain (3.4-4.0%, Răuță and Chiriac, 1980), while the values for the egg-plants leaves, better grouped from the statistical point of view, substantially decease in 2007 as compared to 2006.

Phosphorus contents present a similar situation (Figure 2), this time the values remain around the 2006 average value, for tomatoes as well as for egg-

[13] WRB-SR 1998

plants. The tomatoes leaves phosphorus contents are in the normal content domain (0.3%, Răuță and Chiriac, 1980).

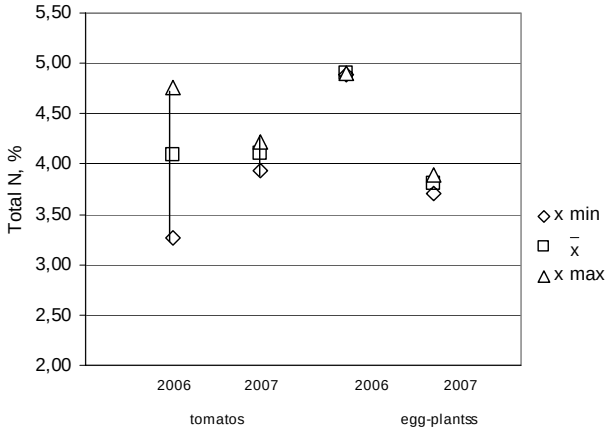

Fig. 1 – Statistical parameters (minimum, maximum and average values) distribution of the total nitrogen contents in the tomatoes and egg-plants leaves in the two experimental years

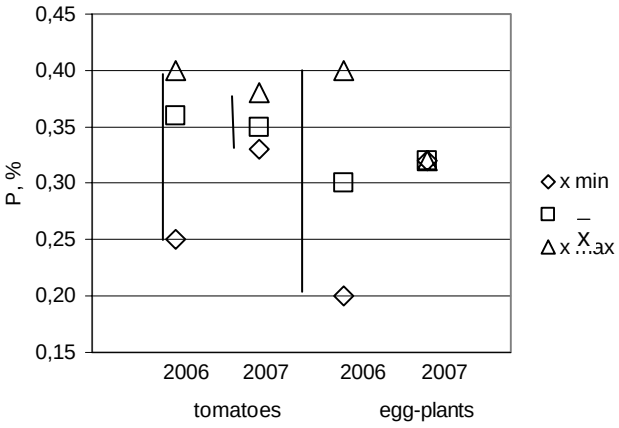

Fig. 2 – Statistical parameters (minimum, maximum and average values) distribution of the phosphorus contents in the tomatoes and egg-plants leaves in the two experimental years

The values of potassium contents in the tomato leaves decreases in 2007 as compared to 2006 (Figure 3) and, from a normal and high nutritional state (2.9-3.4%; > 4.9; Lăcătuşu, 2006) depleted towards a poor nutritional state. This makes

the plants more sensitive to pest generating pathogenic agents (Lăcătuşu, 2006). As a matter of fact, pest control was very difficult in 2007 on these parcels.

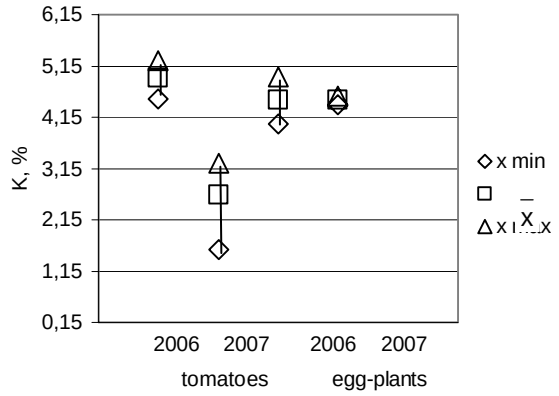

Fig. 3 – Statistical parameters (minimum, maximum and average values) distribution of the potassium contents in the tomatoes and egg-plants leaves in the two experimental years

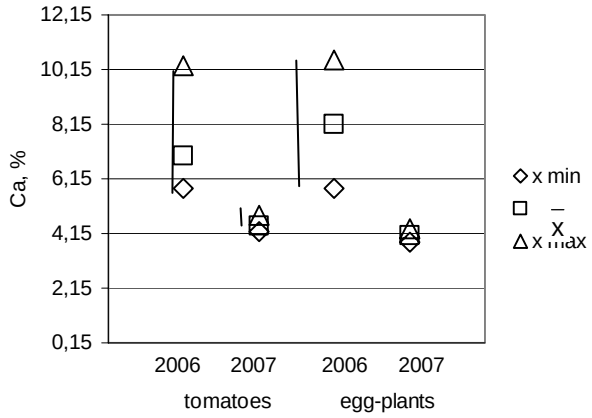

Fig. 4 – Statistical parameters (minimum, maximum and average values) distribution of the calcium contents in the tomatoes and egg-plants leaves in the two experimental years

The tomatoes nutritional state with calcium (Figure 4) is excessive (over 1.8%, after Lăcătuşu, 2006). In 2007 the values decrease bellow the 2006 variation interval, but remain in the excessive nutritional state. It is interesting to observe

that calcium contents have the same values and the same variations in the egg-plants as in the tomatoes leaves.

The magnesium nutritional state of the tomato plants is normal (0.60-1.30%, Lăcătuşu, 2006) in 2006 and decreases bellow this level in 2007 (Figure 5), but without reaching the critical domain (below 0.22 %, Lăcătuşu, 2006). The egg-plants leaves contents are close to the tomatoes ones in this case too.

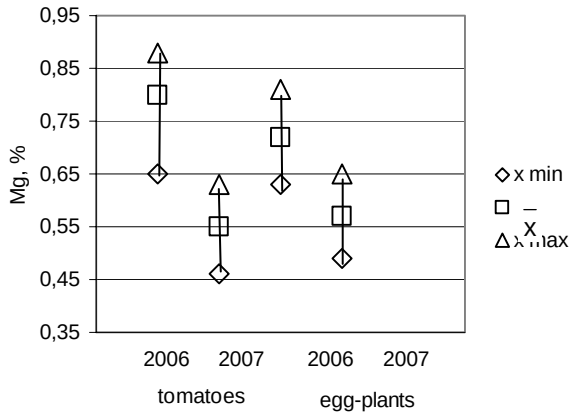

Fig. 5 – Statistical parameters (minimum, maximum and average values) distribution of the magnesium contents in the tomatoes and egg-plants leaves in the two experimental years

The zinc contents in the leaves of the studied vegetables (Figure 6) are much different in tomatoes and egg-plants. The ways these contents differ from one experimental year to the other differ too. Thus, the tomato leaves present a normal content level (41-100 mg/kg, Lăcătuşu, 2006) in 2006 which decreases in 2007 and slightly enters the critical domain (below 30 mg/kg, Lăcătuşu, 2006). The zinc contents in the egg-plants leaves varies in a domain inferior to the tomatoes leaves in 2006, while in 2006 they remain around the same average value. Tomatoes are moderately sensitive to zinc deficiency; zinc contributes, amongst other, to chlorophyll synthesis and fructification (Lăcătuşu, 2006). Indeed, the 2007 yield was poorer and less developed than that of the precedent year.

Copper contents in leaves decreased in 2007 as compared to 2006 (Figure 7) to approximately half for tomatoes and less than a quarter for egg-plants. Nevertheless, the contents remain in the excessive domain (over 15 mg/kg d.m.) for tomatoes which have a moderate sensitivity to copper deficiency (Lăcătuşu, 2006).

The situation is different in the case of iron contents (Figure 8). They almost don't vary at all and remain at an excessive level (over 300 mg/kg d.m.,

Lăcătuşu, 2006). They grow with approximately 25% in the egg-plants leaves in 2007 as compared to 2007 and reach much higher levels as compared to the tomatoes leaves, while in 2007 these levels were close to each-other.

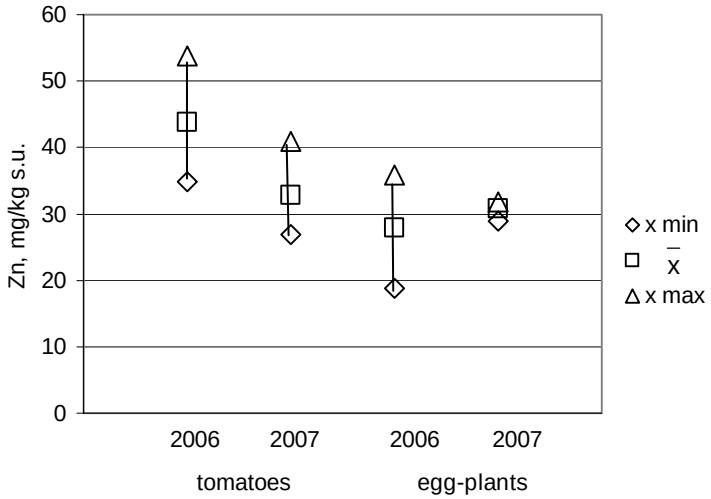

Fig. 6 – Statistical parameters (minimum, maximum and average values) distribution of the zinc contents in the tomatoes and egg-plants leaves in the two experimental years

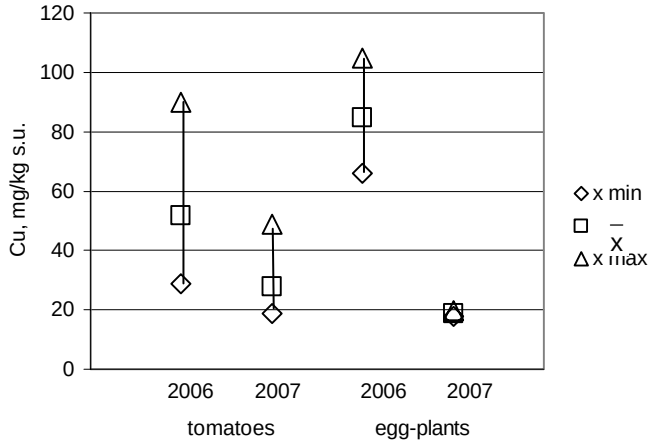

Fig. 7 – Statistical parameters (minimum, maximum and average values) distribution of the copper contents in the tomatoes and egg-plants leaves in the two experimental years

Manganese contents (Figure 9) in the tomatoes leaves are in the normal contents domain (35-240 mg/kg d.m., Răuță and Chiriac, 1980) in 2006, and they decrease to its inferior limit in 2007. In the egg-plants leaves the manganese contents decrease too in 2007 ass compared to 2006; the values remain around the average values for the tomatoes leaves.

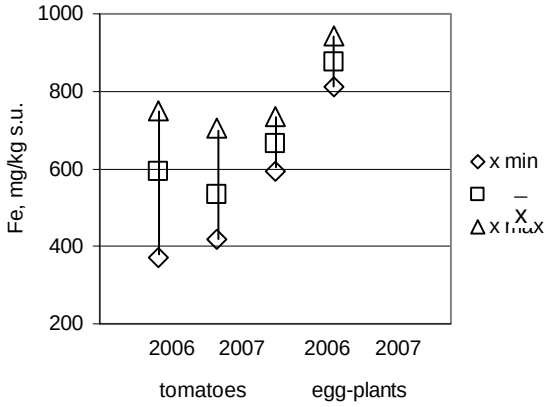

Fig. 8 – Statistical parameters (minimum, maximum and average values) distribution of the iron contents in the tomatoes and egg-plants leaves in the two experimental years

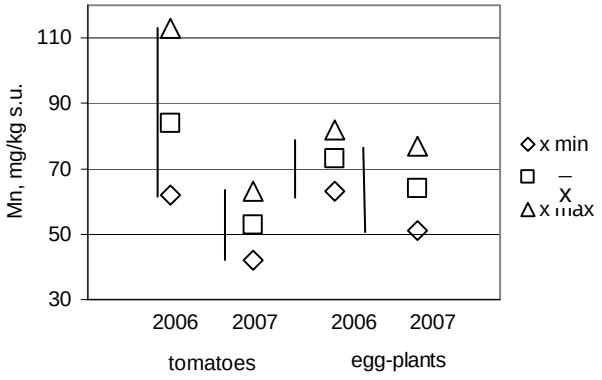

Fig. 9 – Statistical parameters (minimum, maximum and average values) distribution of the manganese contents in the tomatoes and egg-plants leaves in the two experimental years

In 2006 the cellular sap pH values in the studied vegetables leaves are close, both for tomatoes and egg-plants (Figure 10). As a consequence of the variations registered in the leaves, both in mineral composition and ratio between

nutritional elements, the cellular sap pH decreases for both species. The decrease is more pronounced with tomatoes.

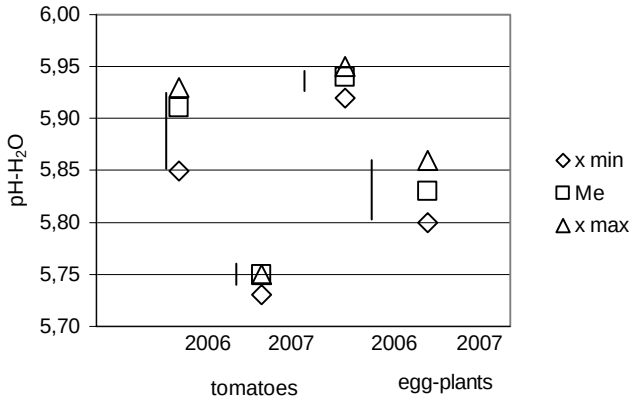

Fig. 10 – Statistical parameters (minimum, maximum and median values) distribution of the pH values in the cellular sap pH of tomatoes and egg-plants leaves in the two experimental years

Conclusions

- The general tendency, in 2007 as compared to 2006, is the decreasing of mineral elements contents in the analyzed vegetables leaves.
- The variations of calcium and magnesium contents are similar in the two vegetable species leaves.
- The variation of mineral elements contents in the tomato leaves is consistent with the nutritional disorders observed (poorer fructification due to the zinc contents decrease, for example).
- At SCDL Bacău, in ecologically certified fields, exclusively organic fertilization doesn't add to the nutritional elements contents of the soil, but has the great merit to maintain the soil fertility properties, along with the natural equilibrium between nutritional elements. The yields are lower than those obtain by mineral fertilization and they have a less uniform aspect. They respond to the demands of a certain consumers category.

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