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NUTRITIONAL CONDITIONS OF CULTURES IN GREENHOUSES IN THESSALIA (GREECE)

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Abstract

The low organic matter content of the soil, salinity and P fixation are shown to be important soil factors with limiting effects on greenhouses cultures in Thessalia. After the harvest of each crop, a large amount of nutritional elements accumulate in the soil and in several cases the common practice of base dressing has no effect.

It is also shown that the N content of the soils is usually satisfactory when the value for soil salinity is higher than 0,2%. On the other hand, plant nutrition of Mg and micronutrients is controlled by the over - application of fertilisers including these elements.

1. Introduction

The last years, increase was marked in greenhouse cultures in Thessalia. Nevertheless the fertilising methods are empirical and characterised by the practice of over - fertilisation (Chouliaras and Mavromatis, 1987). Over - fertilisation, the use of high salinity irrigation water and the absence of drainage networks are factors, which lead to unfavourable situations (Simonis and Grafiadelis, 1985).

Furthermore, the non-improved characteristics of the natural soils employed allow the affections of their limiting effects on productivity.

In this work, we also try to show the quantitative participation of N, P, and K elements in the soil salinity, in relation to soil and irrigation water characteristics.

2. Material and methods

The present study relies on data collected by the research programme 'fertility and salinity of soils in greenhouses in Thessalia', carried out in the TEI of Larissa. These data were obtained in the years 1987 and 1988. 28 greenhouses situated between Volos and Trikala were studied.

2.1. Soil data

- ◆ Nitrogen: Total and water – soluble.
- ◆ Phosphorus: Available (Olsen) and water – soluble.
- ◆ Potassium: Available (exchangeable + water – soluble)
- ◆ Salinity: The total salinity is approximated according to the relation: Soils salts (%) = $EC \times 350$, where EC = electrical conductivity (S/cm) of soil extract (1:5) in water (Hess, 1971).

2.2. Leaf analysis

Leaf composition was determined on dry matter in N, P, K, Mg (%) and Fe, Zn, Mn, Cu (ppm). The precise methods are cited in our previous study (Chouliaras and Mavromatis, 1987).

2.3. Sampling

Sampling was carried out as follows:

Phase So: At the end of the autumn cultural period and before the application of base dressing for winter or spring tomato cultures, soil samples were only taken.

Phase Sa: At the first period of plant development (6-8 weeks after planting) we took soil and leaf samples. The leaf samples correspond to the second mature leaf from the base (cucumber) and to the second mature leaf after the first inflorescence (tomato).

Phase Sb: At the second period of plant development (12-16 weeks after planting) we took soil and leaf samples. The leaf samples correspond to the fourth leaf from the top.

The soil samples correspond to a depth of 0-25 cm.

3. Results

The soils of greenhouses in Thessalia, are characterised by alkalinity and by saturation of the soil complexes with Ca and Mg. This finding is associated with the phosphorus fixing capacity of these soils. The characteristics of several representative soil samples, with limiting effect on the productivity of greenhouses such as low content in organic matter, salinity and alkalinity are shown in table 1.

3.1 Winter tomato cultivations

Producers usually apply base dressing without taking into account the amounts of fertilising agents stored in the soil. Thus the average salinity level is found to be a value of 3160 ppm on sampling made at the So phase (figure 1). In the next two samplings made at the Sa and at the Sb phases, the corresponding values are found to be 5425 and 4060 ppm respectively. In both cases the available fractions of nutritional elements are increased remarkably. In spite of the high soil contents of nutritional elements, the leaf N, P, K composition shows marginal contents (figure 2), according to Winsor and Adams (1987).

The high P levels, shown by the values of available P, indicate an over fertilisation of P. Finally we note normal leaf contents of Ca, Mg, Fe, Zn, Mn, & Cu.

3.2. Summer cucumber cultivations

The analysis of soil samples taken at the Sa and Sb phases indicated lower salinity levels in comparison with tomato cultivation's.

The water – soluble N values show a sufficient soil N content and the leaf analysis brings out the presence of a normal N content in the plant tissues.

3.3. Summer cucumber cultivations

The analysis of soil samples taken at the Sa and Sb phases indicated lower salinity levels in comparison with tomato cultivation's.

The water – soluble N values show a sufficient soil N content and the leaf analysis brings out the presence of a normal N content in the plant tissues. On the contrary the leaf K composition points out a need to intensify the K nutrition of cucumber plants. We come to a similar conclusion if we compare the values of water – soluble K contents of soil samples, with the optimum values, as mentioned by Zuang (1982). The problem appears more intense at the Sb phase on sandy soils.

The dry matter composition shows marginal leaf P content and the water – soluble P fractions are kept at lower levels in relation to the optimum values.

Generally, the plant tissue contents of Ca, Mg, Fe, Zn, Mn, Cu were found to be satisfactory. However, we marked several toxic leaves Cu and Zn contents which should be attributed to high applications of pesticides.

3.4. Nutritional elements of soil

It is usual to find water – soluble N of soil up to 120 ppm when soil salinity is up to 2000 ppm. An exception to this rule was found when salinity irrigation water (EC up to 840 μ S/cm) was applied.

The use of low salinity irrigation water (EC below 750 μ S/cm) leads to a higher participation of the water - soluble nutritional macronutrients N, P, K in the soil salinity. The average values of the following ratio:

$$\frac{\mathbf{N+P+K: (water - soluble), ppm}}{\mathbf{Total salinity, ppm}} \times 100$$

range from 22,5% to 25,5% at Sa and Sb phases respectively when the better quality of irrigation water is used. When its quality is worse (EC over 750 μ S/cm), the corresponding values range from 13,% to 15,8%.

It is also shown that **boron** accumulation in the soil is a function of the increase in soil salinity (unpublished data).

4. Discussion

The high soil salinity observed in tomato greenhouses leads to a reduced productivity. As a result, the stored soil mineral and organic Nitrogen should be taken before application of the base dressing.

In summer cucumber cultivation's we found lower values of soil salinity. Generally the producers are aware of through experience of the greater sensitivity of cucumber to salinity, so they avoid the uses of base dressing. In these cultivation's, although the summer temperature is favourable for P absorption by plants, the soil capacity of P-fixing affects this process negatively.

We underline the large applications of fertilisers, including Mg, in greenhouses in Thessalia. The micronutrients Fe, Z, Mn and Cu are abundantly added by producers through soil or leaf applications. According to our previous publication (Chouliaras and

Mavromatis, 1987), soil with a favourable pH and low content of active CaCO₃, feed tomato cultures more easily with Fe, Zn, Mn and Cu.

In conclusions, we suggest the following important points:

- Generally, the need for increasing the organic matter content of soils is shown.
- The improvement of saline soils and prevention of the induction of salinity could be faced by setting drainage networks.
- In most cases the base dressing should be avoid. As the soil salinity increases up to 0,2%, N fertilisation should not be necessary and could be omitted.

As a rule, although the soils of Thessaly contain active CaCO₃, thus fix P.

A K deficiency appears in cultures, especially on sandy soils, thus a better distribution of K fertilisers should be applied.

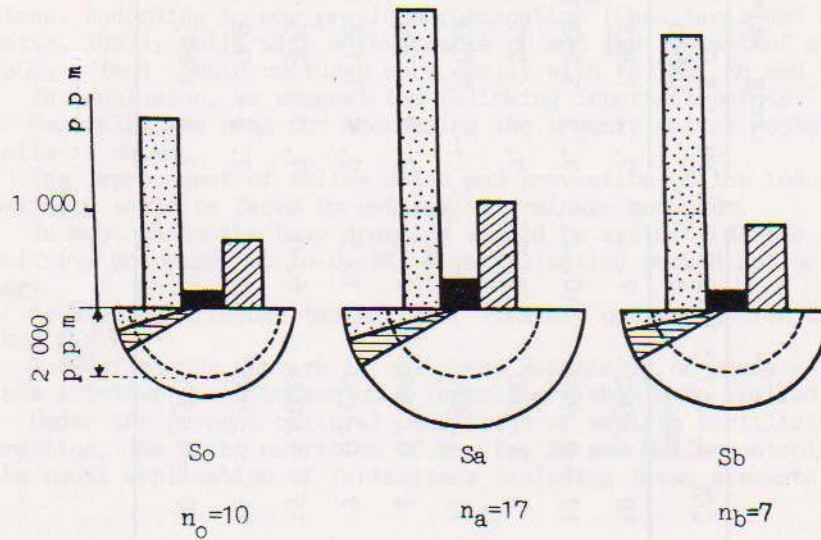
Under the present cultural conditions of empirical fertilising practice, the plant nutrition in micronutrients, is controlled by the usual application of fertilisers including these elements.

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tomatoes

p p m		p p m		p p m	
(S)	:3 160. 0	5 425. 0		4 060. 0	
(Nw)	: 248. 7	461. 9		230. 6	
(Kw)	: 238. 2	429. 3		393. 3	
(Pw)	: 28. 4	31. 3		22. 8	



cucumbers

P P m		p p m	
(S)	:2 468. 5	1954. 2	
(Nw)	: 236. 3	294. 2	
(Kw)	: 150. 7	91. 6	
(Pw)	: 11. 3	12. 4	

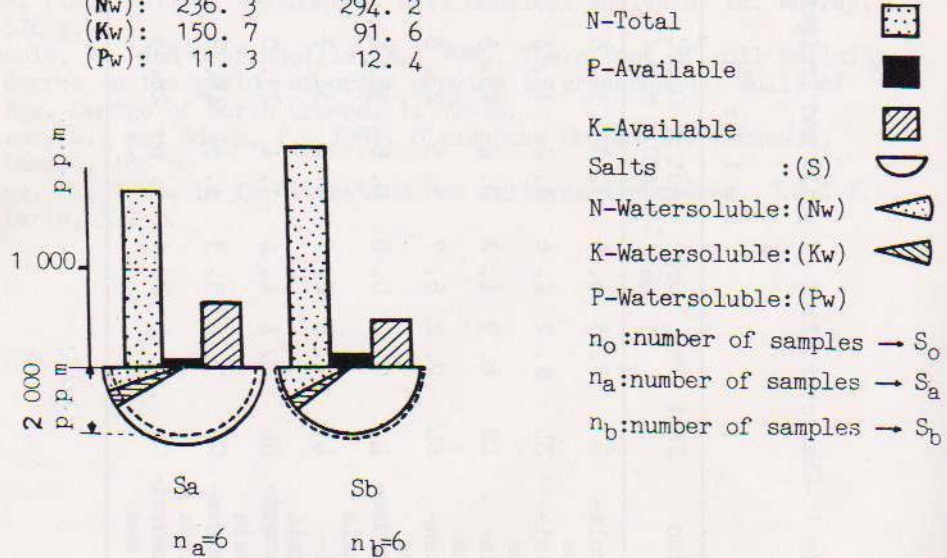


Figure 1- Average distribution of nutritional elements in the soils.

Table 1. Characteristics of soils and irrigation waters

region	text	pH	Soils							Irrigation waters			
			Org Ma t %	Act CaCO3 %	CEC me/100	S/T X 100	C/N	EC (1:5) extract Mmhos/ cm	ESP	pH	EC µmhos/ cm	SAR	Cl Me/ Lt
N.Ionia Volos	L	7,5	6,6	3,1	31,5	sat	10	1,980	7,4	7,2	1823	1,1	6,8
Dimini Volos	SL	8,2	4,6	1,2	17,4	sat	13	0,970	10,4	7,3	3752	13,4	31,3
Agria Volos	LS	6,9	4,2	0,4	13,5	sat	8	1,660	3,2	7,6	777	0,4	1,1
Alikes Volos	SL	7,2	6,7	1,5	23,8	sat	11	1,640	-	-	1050	1,9	4,0
Taxiarches Trikala	L	7,7	0,8	0,8	32,4	sat	4	0,760	2,3	7,9	908	0,5	1,5
Nomi Trikala	L	7,9	2,5	0,4	34,3	sat	9	0,450	1,5	7,7	1186	1,3	1,0
Faneromeni Trikala	SL	7,4	4,4	1,4	23,0	sat	15	1,020	6,0	7,7	375	0,4	0,7
Terpsithea Larissa	CL	7,9	3,3	4,5	45,0	sat	12	1,000	4,7	7,8	969	1,9	1,8
Melissohori Larissa	CL	7,6	2,1	1,6	28,5	sat	10	0,985	-	7,9	1275	-	4,0

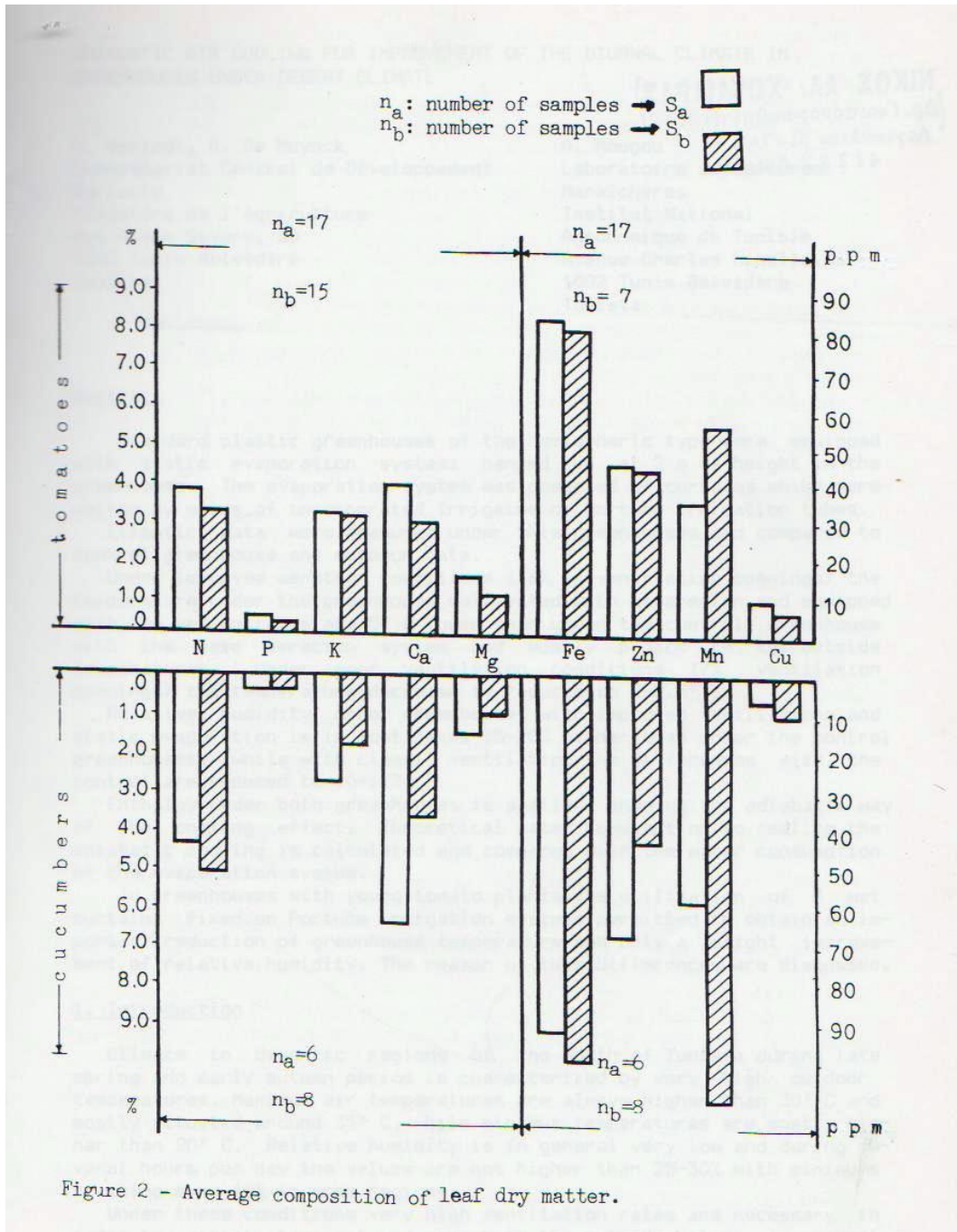


Figure 2. Average composition of leaf dry matter (a, b: phase of sampling)