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FERTILIZATION MANAGEMENT OF GREENHOUSE CROPS BASED ON SOIL SALINITY LEVEL

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ABSTRACT

In greenhouse cucumber plants which were growing in soil with increased salinity (EC 0.66 dS/m), the omission of basic fertilization was tasted. During cultivation period the fertigation programme was organized according to soil salinity level, plant's growth and leaf tissue analysis. Soil salinity declined through cultivation period while plant's yield did not affected by fertilization process. Plant's need for nutrients was partially covered by soil salts and the amount of applied fertilizers was limited. However, significant increase in soil salinity was observed after soil solarisation.

INTRODUCTION

Soil salinity assessment is based on measurement of soil electrical conductivity, a quick, reliable and easy method which could be used during cultivation period for indication of soil fertility in a greenhouse crop (Rhoades et al., 1999).

The application of high fertilizer rates in intensive cultures, like greenhouse crops, affects electrical conductivity. In soils from several greenhouses in Thessaly, which have irrigated with low salinity water, the high electrical conductivity (0.4 dS/m) in soil extracts (soil:H_2O ratio 1:5) is related with the increase concentration of soluble N and K. In these soils the application of N and K fertilizers in the following culture is not recommended (Chouliaras et al., 1991). In addition, the concentration of phosphorus in soil is not affect salinity (Chouliaras et al., 1991).

The mobility of P in soil is very limited and therefore could remains in soil for many years, in contrast with N and K. Thus, the knowledge of P fertilizer applications in formers cultures consists a valuable guide to efficient plant nutrition management.

The aim of this work was to develop a fertilization method for a greenhouse cucumber culture based on soil salinity and fertilizer inputs of the former crops.

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MATERIALS AND METHODS

Soil samples (to a depth of 15 cm) were taken from a greenhouse located at the Technological Education Institute (TEI) of Larissa, Greece, for physical and chemical soil properties estimation. Soil organic matter, ammonium and nitrate nitrogen, available P and exchangeable K were measured following the Page *et al.* (1982) method. Organic matter content was calculated by chemical oxidation of soil with 1 mol/l $K_2Cr_2O_7$ and titration of the remaining reagent with 0.5 mol/l $FeSO_4$.

Soil organic matter was estimated by multiplying soil organic carbon content by the factor 1.724 as reported by Hesse (1972). Both ammonium and nitrate nitrogen were extracted with 0.5 mol/l $CaCl_2$ and estimated by distillation in the presence of MgO and Devarda's alloy, respectively. Available P (P-Olsen) was extracted with 0.5 mol/l $NaHCO_3$ and measured by spectroscopy. Finally, exchangeable K was extracted with 1 mol/l CH_3COONH_4 and measured by Flame Photometry (Essex, UK).

According to analysis, the greenhouse soil was loamy sand, slightly calcareous, with alkaline pH, low organic matter content and high Cation exchange capacity (Table 1). The electrical conductivity of soil extracts (water soil ratio1:5) was 0.66 dS/m, indicating marginally increased soil salinity (Chouliaras et al., 1996).

Table 1.

Chemical soil properties

Soil properties	Values
pH	8.13
$CaCO_3$ (%)	5.8
Organic matter (%)	0.74
Cation exchange capacity (cmol/kg)	23
Electrical conductivity in soil extract (1 soil : 5 H_2O, dS/m)	0.66

Cucumber plants (var. Gador) was transplanting at early April 2008 in greenhouse. During cultivation period (April-July 2008) plants were watering with good quality water (EC = 0.5 dS/m) while the fertigation programme organized according to plant growth, blooming and fruit load, and soil salinity changes. Forty days after transplanting leaf samples were taken for plant inorganic elements assessment.

As the concentration of N and K in plants was found to be low, fertigation programme modified according to CTIFL guide (1989). Totally, during the whole growing period 110 Kg N, 80 Kg P (P_2O_5) and 130 Kg K (K_2O) per hectare were used for plant fertigation. At the end of growing season, soil covered by transparent polyethylene plastic for soil solarisation and the soil electrical conductivity was measured three months later.

The experimental design was completely randomized with four replications. Data analysis was made using the MINITAB statistical package (Ryan et al., 2005). Analysis of variance was used to assess treatment effects. Mean separation was made using Tukey's test when significant differences between treatments were found.

RESULTS AND DISCUSSION

Soil salinity was reduced during growing period (Figure 1). Plant fertilizer application based on soil salinity did not only reduce salt concentration in soil but led to electrical conductivity decline from 0.66 dS/m to 0.24 dS/m at the end the growing season. Table 2 shows the balance of available inorganic elements in the soil during growing period. The availability of minerals is due to fertilizer residues from previous crops and nutrients applied via irrigation in the current crop. These data confirms the use of soil salts from plants.

In addition, it is remarkable the increase of salinity (1.23 dS/m) after soil solarization due to soluble salts mobility to soil surface caused by intensive evaporation. In this case, the salinity level has to be considered for the following crops. According to Chouliaras (1990), is recommended the improvement of soil properties by organic matter application for these greenhouses.

Finally, the fertigation programme did not affect plants yield. The total production of greenhouse cucumber was 6.4 Kg/ m^2.

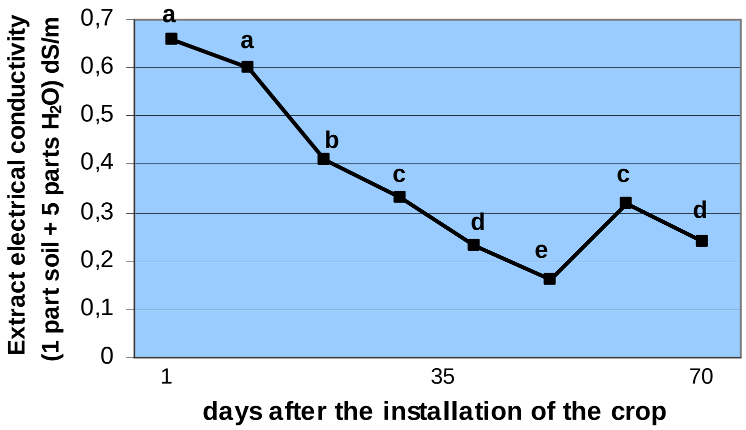

Figure 1. Changes in soil salinity during cultivation period.

Table 2.

Inorganic elements availability

Specification	N (Kg/ha) Inorganic	P_2O_5 (Kg/ha) P-Olsen	K_2O (Kg/ha) Exchangeable	Electrical conductivity
Start of growing season	490	70	1040	0.64 dS/m
Surface fertilizer application	110	80	130	
After soil solarization	730	80	1180	1.23 dS/m

CONCLUSION

This study shows that greenhouse soil salinity due to accumulation of fertilizers could be taken into account for basic fertilizer omission. In this way, plant needs for nutrients might partially be covered by soil salts leading to limited surface fertilizer application and soil salinity reduction by the end of the growing season.

REFERENCES

Chouliaras N. 1990. Organic matter and organic nitrogen in greenhouse soil. Newsletter of Soil Organization, Vol 10-11: 18-20.

Chouliaras N., Mavromatis E. 1991. Nutritional conditions in greenhouses in Thessaly (Greece), Technical Communications of ISHS, International Society for Horticultural Science, Number 287, 221 p.

Chouliaras N. 1996. Greenhouses soil fertility in Thessaly. The Agricultural Association of Larissa, 16: 32-36.

CTIFL. 1989. Memento, Fertilisation des Culture Legumieres. Centre Technique Interprofessionnel des Fruits et des Legumes, France, 398p.

Hesse P.R. 1972. A Textbook of Soil Chemical Analysis. John Murray, London.

Page A.L., Miller R.H., Keeney D.R. 1982. Methods of Soil Analysis Part 2: Chemical and Microbiological Properties. Agronomy, ASA and SSSA, Madison, Wisconsin, USA.

Rhoades J.D., Chanduvi F., Lesch S. 1999. Soil salinity assessment. Methods and interpretation of electrical conductivity measurements. FAO Irrigation and drainage paper 57.

Ryan B.F., Joiner B.L., Ctyer J.D. 2005. MINITAB Handbook: 5th edition. Brooks/Cole-Thomson Learning Inc., Kentaky

Χουλιαράς Ν. 1990. Οργανική ουσία και οργανικό άζωτο στα εδάφη των θερμοκηπίων. Ενημ. Δελτ. Εδαφ. Εταιρ. Αρ. 10-11, σελ. 18-20.

Χουλιαράς Ν. 1996. Τα εδάφη και η γονιμότητα τους στα θερμοκήπια της Θεσσαλίας. Το Βήμα του Γεωπονικού Συλλόγου Λάρισας. Αριθ. 16, σελ. 32-36.