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TOMATOES SOILLESS CULTURE IV ; INFLUENCE OF THE TOTAL CONCENTRATION OF THE NUTRIENT SOLUTION AND ITS POTASSIUM CONTENTS

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TOMATOES SOILLESS CULTURE
IV. INFLUENCE OF THE TOTAL CONCENTRATION OF THE NUTRIENT SOLUTION AND ITS POTASSIUM CONTENTS.

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INTRODUCTION

Continuing our studies about tomatoes on soilless culture (Pérez Melián, et al. 1976) and trying to locate the variation limits of nutrient solution composition (total concentration and anions and cations relation) in which there is neither influence in the production nor in the fruit quality, it has been programmed a test with different nutrient solutions, Universal solution variants of A. Steiner.

METHODS

The test was done in 16 soilless beds, set and connected on latin square sketch (4 x 4). Each bed has an area of 6.20 square metres, (6.20 x 1.00) and a depth of 20 cm. As substrate, was used lapilli ("picón") (Luque and Pérez Melián, 1975) and the irrigation system was the subirrigation one according to the Dutch method (Steiner and Pérez Melián, 1978).

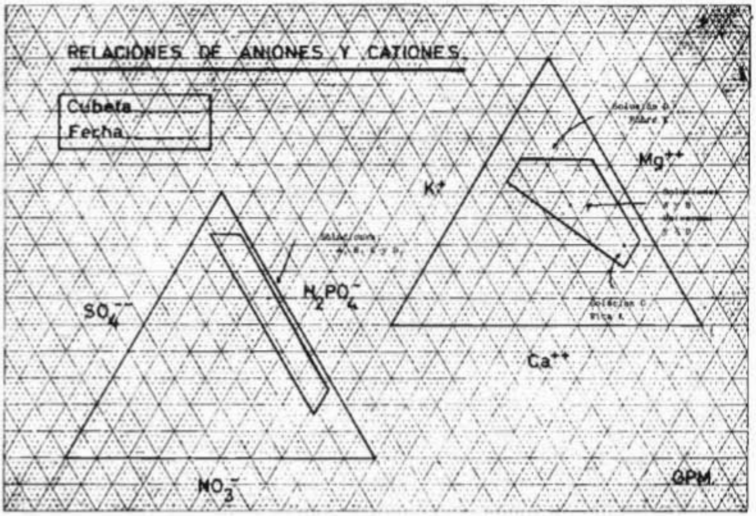
Nutrient solutions.
The nutrient solutions were four (Table 1) which correspond to one Universal solution (Steiner, 1968) and three other solutions of half concentration of the Universal solution. Simultaneously three differents potassium contents were used.

Table 1. NUTRIENT SOLUTIONS. Macronutrients. (meq./L.)

Solution	NO_3	H_2PO_4	SO_4	Ca	Mg	K	Name
A	12	1	7	9	4	7	Univers.
B	6	0.5	3.5	4.5	2	3.5	½ U.
C	6	0.5	3.5	3	1	6	Rich K
D	6	0.5	3.5	6	2	2	Poor K

The Potassium percentage in the solutions A and B is 35% of the cations, in the solution C (rich K) 60% and in the solution D (poor K) 20%. (Graphic 1).

Graphic 1. Anions and cations relation.



The micronutrients concentration during the growth is in accordance with Table 2.

Table 2. Nutrient solutions. Micronutrients. (ppm).

Micronutrient	Mn	B	Zn	Mo	Cu	Fe
Concentration	1.4	0.5	0.09	0.04	0.02	2

The nutrient solutions were analyzed weekly and the spent nutrients replaced, with the purpose of holding the solution composition constant.

The analytical determinations obtained were: pH, conductivity, nitrates, phosphates, sulphates, calcium, potassium, magnesium, chloride and sodium. The micronutrients were occasionally analyzed.

Growth.
The sowing was realized with tomato cv. "Tropic" in soilless bed covering the seed with thin lapilli, in order to get a better contact with the substrate.
25 days after sowing, the seedlings were transplanted to the experimental beds. As plantation frame were used two rows of plants per bed and 40 cm. between plants; what makes a density plantation of 4.52 plants a square metre of bed.
After the transplanting and during 10 days were applied three irrigations a day which were gradually reduced to only one irrigation a day.
The summary of the principal phases ofgrowth is the following:

Seėd-plot duration	25 days
Production start	76 days after transplanting
Picking period	98 days

The parameters observed for quality control of the fruit, were: 1st. quality (fruits with an average weight exceeding 150 g.); 2nd. quality (fruits with an average weight lower than 150 g.); pH and conductivity of the whole fruits extract.

RESULTS

The summary of the production data is shown in Tables 3 and 4. In the first one, the test results are related in Kg. per plant, and in the second one, are in Kg. per square metre of bed.

Table 3. Tomatoes production. Kg./plant.

D = 4.8	A = 5.5	C = 4.7	B = 4.6
C = 5.1	B = 4.5	D = 4.2	A = 4.6
B = 4.2	C = 4.2	A = 4.4	D = 4.5
A = 4.8	D = 5.2	B = 4.9	C = 4.5

Table 4. Tomatoes production. $Kg./m^2$ of bed.

D = 21.6	A = 24.8	C = 21.2	B = 20.9
C = 23.0	B = 20.1	D = 19.1	A = 20.8
B = 18.9	C = 19.0	A = 19.7	D = 20.4
A = 21.5	D = 23.4	B = 22.1	C = 20.2

The analysis of latin square variance is shown in Tables 5 and 6. The results show no existence of significant differences in any of the two cases analyzed, so the incidence of the different nutrient solutions over the production is the same.

Table 5. Statical analysis. Kg./plant.

Source	DF	SS	MS	F
Rows	3	0.83	0.28	2.00
Columnes	3	0.25	0.08	0.57
Solutions	3	0.16	0.05	0.35
Error variance	6	0.83	0.14	
Totals	15	2.70		

$K_1 = 3$

$K_2 = 6$

$F_{0.05} = 4.76$; $F_{0.01} = 9.72$

Table 6. Statical analysis. Kg./m^2 of bed.

Source	DF	SS	MS	F
Rows	3	16.84	5.61	1.96
Columnes	3	4.57	1.52	0.53
Solutions	3	3.08	1.03	0.36
Error variance	6	17.11	2.85	
Totals	15	41.60		

$K_1 = 3 \qquad K_2 = 6$

$F_{0.05} = 4.76, \; F_{0.01} = 9.72$

The Table 7 shows a summary of the production quality. The first column shows in percentage in weight of the first quality fruits. The second and third ones show the average weights in grammes of the first and second quality; the fourth column shows the conductivity of fruits extract, and the fifth one the pH of the extract above mentioned.

Table 7. Quality data.

Treatment	% 1st	g.(1st)	g.(2nd)	mS	pH
A	71.6	231	134	4.35	4.17
B	63.2	226	136	4.42	4.16
C	69.5	232	134	4.53	4.15
D	70.6	234	137	4.47	4.18

The statical analysis of these results (averages) by the "t of Student" test, did not give any significant evidence among them.

DISCUSSION

Even at the first sight, the results obtained in the experiment do not look promising;nonetheless, we believe these can be very positive, and from them we can obtain several important conclusions for the practical development of soilless culture.

Firstly and in relation with the total concentration of the nutrients solution, we have obtained concordance with the results of one experiment carrier out in 1976. Thereafter we found out that the solution with 0.35, 0.70 and 1.05 at. of osmotic pressure, and with anions and cations relation according to the A. Steiner's Universal solution, they had no influence on the tomato production. Now, the results have coincided using 0.35 and 0.70 at. solutions. This allows us variations in the total concentration of the nutrient solution. So if we initially use nutrient solutions of 0.35 at., it will not exist any danger for the production, when this solution is slowly concentrating because of the evaporation and the plants transpiration.

Secondly, we see that while the cations relation stays within certain limits (Graphic 1), there won't be any danger altering the production. All of this is in accordance with the above mentioned carried out experiment in 1976, in which we changed the Nitrogen relation in the solution and fundamentally with the obtained conclusions from A. Steiner in this work presented at the 3th IWOSC's International Congress "The selective Capacity of Tomato Plants for Ions in a Nutrient Solution" in which he strongly states: The tomato plants have a strong capacity of selection for the ions".

According to the above mentioned, the nutrient solution can change within limits of total concentration and ions relations during the growth, what allows us to lengthen the control or analysis of the solution, a limitating factor in some cases for the soilless culture development.

CONCLUSIONS

- The variation of the total concentration of the nutrient solution, between 0.35 and 0.70 at. does not influence either the production nor the quality of the tomato fruit cv. "Tropic" grown by soilless culture.

- The Potassium level in the cations relation can change between 20% and 60% of equivalents without affecting the production and the fruit quality.

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S U M M A R Y

In the present paper, the total concentration of the nutritive solution and the relative concentration of the Potassium ion have been studied. Two solutions of total concentrations each of 0.35 and 0.70 at. and three solutions of relative concentrations of Potassium each 20, 35 and 60% of the cations have been used. No significative diffrences have been found in the treatments.