THE INFLUENCE OF WATER SOURCE FOR PREPARING THE NUTRIENT SOLUTIONS USED FOR CUCUMBERS IRRIGATION IN HYDROPONIC GREENHOUSE

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Abstract

Modern greenhouses are using, today, hydroponic systems with the latest technology. Temperature, ventilation and amount of fertilizer are computer controlled, the works in green and cucumbers harvesting are only manually operations performed. However, sometimes during the growing season on plants, acts, with depressive effects, some water sources insufficient controlled. So, in hydroponic greenhouse are some essential factors that contribute to the growth and plant development and is necessary to be constantly monitored. The paper presents the influence on the cucumber plants of the irrigation water quality, coming from deep drilling and from melted snow and collected in special tanks.

Key words**:** *cucumber plants, irrigation water, greenhouse*

INTRODUCTION

Hydroponic culture is one of the new trends in horticulture. It is called the culture without soil, which involves the growth of plants with their roots in a nutrient solution performed by diluting in water of fertilizer according to plant needs. The plants grow on substrates made from inert mineral wool. These inert materials are wetted, at regular intervals, with nutrient solution which should include, in certain proportions, all elements (minerals and trace elements) which the plant, normally extracted from the soil: nitrogen calcium, magnesium, sodium potassium, iron, etc.

In hydroponic greenhouse are some essential factors that contribute to the growth and plant development and is necessary to be constantly monitored.

The most important factor is the pH of the nutrient solution that depends on the type of water and nutrients used. pH outcome will influence the absorption of nutrients by plants and is recommended to be 6.2 to 6.8 pH units.

Another factor is the salts accumulation. The excess of salts leads to the occurrence of toxicity phenomena that manifests through the leaves chlorosis, the stems dryness and root mass reduction, proportionally to the intensity of this phenomenon. At cucumber plants grown in hydroponic systems, in Pipera greenhouses, belonging to SC Leader International SA, have appeared visual symptoms caused by possible nutritional deficiencies.

MATERIAL AND METHODS

Samples were collected from several rows located in the area occupied by the cucumber plants. Also, because during the growing season some plants were irrigated, for a period of time, with water from melting snow, this technological intervention was taken into consideration in interpreting the results. So, 26 samples were collected from plant material, in

which 13 samples of leaves and 13 samples of roots. These samples of plant material were average samples, each consisting of 5 subsamples.

In laboratory were determined the contents of macro (N, P, K, Ca, Mg, Na) and trace elements (Fe, Mn, Cu, Zn), using standardized analytical methods. Nitrogen was determined by the Kjeldahl method, phosphorus spectrophotemetrically, potassium, sodium and calcium flam photometric, magnesium and trace elements were determined by atomic absorption spectrometry in the variant by air-acetylene flame atomization.

In order to interpret the analytical results, average values were calculated on the two plant organs analyzed, according to the nature of the water used for irrigation and the degree of damage of the plants. Also, depending on the damage degree of plants were calculated average values of content elements, values that were compared with the limits for normal content interpretation of leaves from three sources: after the German school (Bergmann and Neubert), English school and after the Research and Development Institute of Vegetables and Flowers from Vidra (dr. V. Lacatus). The interpretation values relates to the cucumbers in greenhouses, and in some cases specifying the hydroponic growing system (tables 2 and 3).

RESULTS AND DISCUSSIONS

To determine the cause of the toxicity phenomenon, samples were collected from plants affected in different degrees: in proportion of 100%, in proportion of about 20% and apparently healthy plants (photo 1). The appreciation was performed macroscopically.

100% plants affected 20% plants affected apparently healthy plants

Fig 1: Plants affected in different degrees

The average analytic data separated by the degree of damage and by the nature of irrigation water used, for a time was used water from snowmelt (table 1) clearly highlights certain differences. Thus, in the root of plants continuously irrigated with drilling water the Na content is much higher, up to 1.52% as compared to the Na content in the plant roots with the same degree of damage (20%) of melting snow irrigated. This phenomenon was maintained, as sense of intensity, also in leaves. It is obvious the leaves sodium content of the plants affected in their entirety. The leaves sodium content of the plants irrigated with drilling water is 1.71% higher that in the leaves of plants temporary irrigated with melting snow water. Is worth mentioning, that all these values, regardless of the damage degree, are higher than normal sodium leaves content in the cucumber plants (0.40%). As compared to the value of 0.40%, the sodium leaves content of the plants total affected and irrigated with drilling water only it is 7 times higher. At the other chemical elements were not reveal major differences in their concentration in the roots and leaves, depending on the nature of the irrigation water.

Table 1

Comparing values of macro elements average contents (%) of cucumber plants irrigated with water from snowmelt and drilling water

Degree damage of plant	Roots		Leaves	
	snowmelt water	drilling water	snowmelt water	drilling water
NITROGEN				
apparently healthy plants	2,40	2,73	3,57	3,45
20% plants affected	2,71	3,24	2,60	2,94
100% plants affected	2,07	2,85	2,84	3,00
PHOSPHORUS				
apparently healthy plants	1,50	0,65	0,536	0,413
20% plants affected	0,66	0,60	0,521	0,367
100% plants affected	1,75	0,64	0,418	0,570
POTASSIUM				
apparently healthy plants	3,00	3,03	3,91	3,60
20% plants affected	3,16	3,07	4,97	3,27
100% plants affected	2,49	3,24	4,81	4,75
SODIUM				
apparently healthy plants	2,55	3,80	0,49	0,60
20% plants affected	1,83	3,35	0,88	0,77
100% plants affected	1,31	2,23	1,10	2,81
CALCIUM				
apparently healthy plants	1,28	1,40	7,57	6,88
20% plants affected	1,28	1,56	9,33	6,97
100% plants affected	1,83	1,52	8,31	6,73
MAGNESIUM				
apparently healthy plants	0,39	0,40	1,06	1,03
20% plants affected	0,27	0,52	1,03	0,94
100% plants affected	0,51	0,43	0,94	0,93

Regarding the leaves content of the main macronutrients (N, PK) of apparently healthy plants or various degree damage plants, reveals the presence of different normal ranges of nitrogen content (table 2). Thus, Bergmann and Neubert range content is more closely and to a lower content, compared with higher values proposed in the UK or our country by ICDLF Vidra.

Table 2

The macro elements average contents (%) of the cucumber leaves, grown in Pipera greenhouse, in hydroponic system, compared to different interpretation ranges for normal content

NITROGEN			**PHOSPHORUS**			**POTASSIUM**		
Plants			Plants			Plants		
healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%
3,55±0,27	2,77±0,46	2,92±0,27	0,47±0,03	0,44±0,09	0,49±0,09	3,95±0,67	4,11±1,09	4,78±0,72
Bergman and Neubert *2,2-2,8*			*0,22*			*2,5-5,4*		
ADAS Marea Britanie *3,5-5,5*			*0,35-0,8*			*3,0-5,0*		
V. Lăcătuş (ICDLF Vidra) *4,1-7,0*			*0,35-0,7*			*2,5-5,4*		

SODIUM	**CALCIUM**	**MAGNESIUN**

Plants			Plants			Plants		
healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%
0,51±0,09	0,83±0,14	1,95±0,99	7,43±0,50	8,15±1,40	7,52±1,03	1,05±0,07	0,99±0,14	0,93±0,09
Bergman and Neubert		*0,40*	*5,7-11,0*			*0,6-1,3*		
ADAS Marea Britanie			*2,0-10,0*			*0,4-0,8*		
V. Lăcătuş (ICDLF Vidra)			*5,6-11,0*			*0,6-1,3*		

For the average values of nitrogen content in the analyzed leaves, it was found that they are between 3.55% for apparently healthy plants and 2.77 those affected. These values are within the normal ranges offered by different authors.

Referring to P, K, Ca and Mg it was found that these chemical elements are within the normal range of content.

Regarding the sodium content was recorded a clear increase from 0.51% to 1.95% with increasing the degree affectation. Considering the normal value content of 0.4% proposed by Bergmann and Neubert in Germany and by Champan in USA it appears that even apparently healthy plants have in their leaves a Na content by 0.11% higher, the 20% affected plants with 0.43% and by 1.55% higher, the affected in its entirety plants, or 4.9 times more sodium than normal content.

The content of metallic trace elements (Fe, Mn, Cu, Zn) has not wavered significantly according to the degree of damage (table 3). However, the range of Fe content (90-106 $mg \cdot kg^{-1}$) was recorded in the left side of the normal range content given by different authors, in contrast the variation range of Mn (304 - 391 $mg \cdot kg^{-1}$) which was in the right side of the normal range content. Therefore, it would appear that there is a slightly deficit of Fe content and an increased in Mn.

Table 3

The microelements and heavy metals average contents ($mg \cdot kg^{-1}$) of the cucumber leaves, grown in Pipera greenhouse, in hydroponic system, compared to different interpretation ranges for normal content

IRON			**MANGANESE**			**COPPER**		
Plants			Plants			Plants		
healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%
106±31	90±36	93±0,5	304±163	335±164	391±141	8,6±2,1	11,2±6,9	10,7±6,0
Bergman andNeubert		*150-250*	*21-71 (hydroponic)*			*10-18*		
ADAS Marea Britanie		*150-250*	*100-300*			*7-17*		
V. Lăcătuş (ICDLF Vidra)		*120-420*	*101-300*			*7-10*		

ZINC			LEAD		
Plants			Plants		
healthy plants	affected 20%	affected 100%	healthy plants	affected 20%	affected 100%
69±33	86±66	117±76	25,1±4,6	36,3±8,5	28,8±4,2
Bergman and Neubert 60-70 (hydroponic)					
ADAS Marea Britanie 40-100					
V. Lăcătuş (ICDLF Vidra) 90-150					

Although there is a trend of increasing concentrations of Cu and Zn with increasing levels of damage, still the ranges of these two trace metal content are within the normal range of concentration in cucumber leaves.

Curiously was the occurrence of lead in the cucumbers leaves, at a double level the of the plant normal content (15 $mg \cdot kg^{-1}$), when at a hydroponic culture, theoretically, should occur, or not occur at a much lower levels, as are other metal micronutrients without nutritional role (Cd, Co, Cr, Ni).

CONCLUSIONS

- ✓ Na content of roots only irrigated with drilling water is up to 1.52% higher than the content of Na from root plants irrigated with water from the snowmelt;
- ✓ The phenomenon sense is preserved at the cucumber leaves, reaching in total affected plant leaves a difference of 1.70% between plants irrigated with drilling water and the plants irrigated with water from snowmelt;
- ✓ All Na plant contents, regardless of the irrigation water used, surpass the normal concentration of this chemical element in the plant organs analyzed;
- ✓ Regardless of the source of irrigation water used, the concentrations of other chemical elements (N, P, K, Ca, Mg) content fluctuates in normal range;
- ✓ On average the Na content of cucumber leaves is 7 times higher than normal contents indicated by the scientific literature;
- ✓ The contents of N, P, K, Ca and Mg in the cucumber leaves are within the normal ranges after the data taken from the scientific literature;
- ✓ The content of the metal micronutrient lies, also, in areas of normality.
- ✓ Lead concentration from the cucumbers leaves is twice as high as normal content of the plant (15 $mg \cdot kg^{-1}$).

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