NUTRITIONAL REQUIREMENTS OF SUBSTRATES FOR ORNAMENTAL PLANT CULTIVATION

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1. INTRODUCTION

It is well known that growth and yield of horticultural crops can be greatly increased by optimizing the nutritional status of the root environment. Based on plant response, involving numerous fertilizer experiments for the different plants and substrates involved, guidelines can be proposed for optimal nutrient solution and pot substrate conditions.

The main factors to be considered are sampling technique, pH, electrical conductivity (EC) and the chemical plant substrate composition (nutrients as well as other constituents such as Na, Cl, and the like).

1.1. Sampling technique

Since it is know that the samples contribute to the larger part of the total variability, the error due to sampling soil or substrate is generally greater than that due to the actual chemical analysis (COOKE, 1967; PECK and MELSTED, 1973; MOERMANS and GABRIELS, 1981). With special reference to pot plants extreme care should be taken **not** to include the uppermost substrate layer (0.5-1 cm) of the pot. Due to evaporation, nutrients migrate to this surface layer, thus transforming the latter into saline zone.

1.2. pH and EC

Taking into account the tremendous pot plant assortment being cultivated and available on the market, it is evident that the pH of the substrate, within certain limits, is culture dependant. The same applies for the EC. In Belgium, Italy and France and on an official basis (norms,

import regulations) pH and EC are generally determined on a 1:5 volume basis.

Because of the wide variety of testing methods in use in a great many other laboratories, quantitative terms can be useless and confusing to the grower as well as to the professionals who are aware of all the pitfalls in interpretation. In the future, a solution to this communication gap between laboratories could be offered through the activities of the I.S.H.S. Working Group on Standardisation of Analytical Methods. Recently, both the Glasshouse Crops Research and Experiment Station (Naaldwijk, The Netherlands) and our Institute, are trying to find a common denominator for comparing soil test results from different labs. In this way pH-H_2O norms could be proposed as follows: low 3.5-5.5.; normal: 5.0-6.5; high: >6.5. Criteria for low and high EC are respectively: 500-1500 μ S (Naaldwijk: 1:1.5 volume basis) and 200-600 μ S (Melle, 1:5 volume basis).

1.3. Nutrients and other constituents

Here confusion is even greater. Due to the great many extracting agents being used, no uniform system for calculating and reporting analytical results in terms of evaluating the substrate nutritional status has yet emerged. An example of guidelines (GABRIELS *et al.*, 1984) for salt tolerant, peat cultured pot plants and for our laboratory procedures is given in table 1. Again and in order to compare with other lab criteria, a common denominator, e.g. a reference method (the saturation extract?) has to be found.

2. EXPERIMENTAL RESULTS

Experiments were carried out illustrating the influence of physical and chemical properties of pot substrates in relation to various growth parameters (root growth, plant height, number of leaves, leaf width...). Subirrigation regimes were also taken into account.

8 peats, varying in origin and from coarse to fine textured (vol. % air from 8.3% to 36%; vol. weight 44-147 g/l) and with *Ficus Benjamina* L. and *Schefflera arboricola* Hayata as pot plants wer subjected to 4 subirrigation regimes (1.5-3-6 and 12 min., twice daily) for 5 months (June-November 1984). Fertilizer conditions of the 4 recirculating water culture systems were identical. Best overall results were obtained on peats having high vol. % air and subirrigated twice daily during only 1.5 min. Root development of the plants was also markedly better here.

In another study, Bromeliads (*Aechmea* 'Romero' -MEKERS, 1984-, *Vriesa ospinae* Luther and *Neoregelia* 'Perfecta Tricolor') were grown in recirculating water cultures in 3 peat/perlite mixtures (90/10; 80/20 and 70/30), together with a control (100% peat).

The pot plants were subjected to pH 5.6 and to 4 EC levels (1500-1800-2100-2500 μ S) and watered daily (6 min.; culture period: December 1984 - May 1985). Vol.% air of substrates was 34.5 (control) - 37.5 - 43.4 and 61.4%

respectively. Best overall plant growth and root development was noted on troughs with 2500 μ S and 80/20 peat/perlite mix.

TABLE I

Optimal chemical conditions in the substrate for peat cultured pot plants. Based on water (pH, EC, N, Cl, Br, F) and ammonium acetate (pH 4.65) extraction (1:5 vol./vol.). All element values as mg per l substrate

pH-H_2O	:	**4.5 - 6.0**	**Na:**	$\leqslant$ 50 normal
EC (μ S)	:	200 - 425		50 - 150 higher than normal
N	:	30 - 140		150 - 200 on the high side
P	:	> 30		>200 leaching necessary
K	:	150 - 360	Cl:	$\leqslant$ 50
Ca	:	>400		50 - 250
Mg	:	150 - 300		250 - 300 id.
Fe	:	1 - 5		>300
Mn	:	1 - 5		
Cu	:	0.2 - 2	Br:	< 30
B	:	0.5 - 2	F:	<1.5
Zn	:	0.2 - 1		
Mo	:	0.05 - 0.1		

3. CONCLUSIONS

On balance we believe that soil physical parameters, especially aeration is of outmost importance in automated water culture techniques.

On the other hand, and because no chemical test can simulate all the various conditions which exist in the root environment during the whole period of crop growth, samples of the nutrient solutions as well as from the substrate should be taken on a regular basis, hence optimal plant nutrition can be ensured.

Soil-plant-water relations, in particular transpiration and water use efficiency of the plants, depending on the available radiation (winter-summer), are to be taken into account in connection with optimal watering conditions.

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