Announcement PCS - Indoor Plants

Aqua-Hort announces first results

Growers' requests led to Aqua-Hort® being tested in PCS's trial year 2004-2005. Aqua-Hort® has been a household word among Danish pot plant growers for some years. 2004 was the year it was launched in The Netherlands. Growers using Aqua-Hort® have one primary aim – achieving stronger and therefore better growing plants. Not only has Aqua-Hort® achieved this aim but it has also proven again and again its ability to prevent root rot. Our first trial started in August 2004 and we can already brag about remarkable results!

What is Aqua-Hort®?

Aqua-Hort® consists of a series of copper staves, an electromagnet and a Control box. Aqua-Hort® is installed in the water circuit downstream of the fertilizer mixer. Nutrition water streaming through Aqua-Hort® has copper ions added to it. (Easier absorbed and transported through the plant.) The required needed amount of ions can be set in the control box. The added amount is visible on a display. Besides this, a built in flow meter adjusts varieties in streaming automatically. The complete Aqua-Hort® is formed from stainless steel. Aqua-Hort® can be delivered in different sizes. According to the requested demand one can choose from an Aqua-Hort® which supplies $5m^3$ nutrition water per hour. (Purchasing price ± € 3000,-) or an Aqua-Hort® which supplies 130 m^3 per hour. (Purchasing price ± € 12.000,-) Batteries with copper electrodes have an average life span of 4 years and after that can easily be replaced. (Purchasing price € 270,- till € 740,- depending on size necessary.)

What does the Aqua-Hort® do?

Aqua-Hort® has a double function. It supplies a controlled supplement of copper ions to the irrigation water and it gives the water an electro magnetic treatment. A controlled supply of copper ions is desired only if copper in its ion form (Cu^{++}) is better absorbed and transported through the plant. However, an exact supply of copper as ion is not evident due to copper ions easily binding characteristic. Normally copper is simply added to the fertilizer tray. By reacting with other binding and organic leftovers a part of the copper ions loses its charge due to the level of the fertilizers dose, an other part disappears in the storage of nutrition water in the basin. Due to this it is impossible to calculate just how many copper ions, via the nutrition water, actually reach the plant. Aqua-Hort®, being combined with the direct supply waterline to the plants (after the storage basin for nutrition water) supplies copper ions only to water going to the plant. Before they have the chance to discharge the ions are already by the plants. This forms a controlled supply of copper. According to Mr. De Lasson, the brain behind Aqua-Hort®, this feeding machine could personify a change in the fertilization area: "Now copper is being dosed under control but this could also be applicable for Iron or Zink". Correctly supplying these elements is of utmost importance to keep the plant in a good condition. Cu has proven to be able to make the plants stronger (tougher and less breakable) and to improve the plants' resistance to illnesses. Another visible advantage is the production of nicer whiter roots in many races.

The **electromagnetic water treatment** supplied by the flow of Aqua-Hort® could provide another positive effect – it diminishes the particles in the nutrition water thus enabling them to be absorbed easier: "Ions in water are charged particles with hydrate layers around them. Due to the electromagnetic treatment with dynamic electro magnetic pulses the hydrate layers are removed, and the ions will, therefore, obtain an easier passage in the plants", according to Mr. De Lasson. Increased absorption of feeding elements means increased growth, we conclude!

Copper Doser

The dosage via Aqua-Hort® can be regulated according to the infection risk and sensitivity of the race. The usual setting of usage is 0.5 ppm copper ions (Cu^{++}), towards summer this can be increased to 1.0 ppm and for very sensitive races to 1.5 ppm.

The dose in the plant area can be controlled by the grower himself. As an added help Aqua-Hort® suppliers provide Test-sets (Aquaquant, Merck) with each machine; by usage of a colour scheme it is possible to judge how many copper ions are actually being dosed. During recirculation of the irrigation water a lower Cu level is possible, only if the Cu ions not absorbed by the plant return to the irrigation water storage basin, indeed discharged. When this Cu streams back through the Aqua-Hort®, the electromagnet also charges this copper and consequently there is a surplus of copper ions besides the set copper supply.

Copper Value in Practise: Verbal and written information.

Copper in the irrigation water:

- A normal dose of copper in the irrigation water is 0.1-0.2 mg/l irrigation water or 0.1 to 0.2 ppm.

Copper in the leaf:

- Most literature sources state the Cu value in the leaf is between 5 and 15 mg/kg DS (or ppm).
- "Plant Analysis Manual" states an average Cu need from 3-7 ppm, whereas toxicity can occur from 20-30 ppm, on the other hand shortage can occur with < 4 ppm.

Excess is often demonstrated in the first place in chlorose symptoms (yellowing of the leaf due to antagonisme with FE); also the root growth, and after that the plant growth can be stunted by very high copper concentrations at root level.

Trial period with indoor plants at the PCS

Since August 2004 (week 32) PCS's department indoor plants has held a test. Plants receiving a normal nutrition circuit were compared to plants receiving a nutrition circuit supplied by Aqua-Hort® (mobile miniature version of 5 m^3 nutrition water per hour). Trial plants used were Hedera- Helix "Esther" and Spatiphyllum "Alfa". Plants were given 1 to 2 times a week water depending on the light level. This took place via low irrigation on low and high tide tables. The surplus water was recirculated.

As trials took place in summer conditions and by two races sensitive for root rot, a supply of Cu^{++} of 1.5 ppm was given. This high supply was also chosen in order to see if an accumulation of Cu could be found in the irrigation water (due to recirculation). Another reason for the choice was to control if a continuous supply of a lot of Cu would create the problem of copper excess symptoms in the plants. With week 50 the dose was decreased to 0.5 ppm in order to see how quickly the copper level of the recirculated irrigation water would decrease.

Progress of Copper level in the irrigation water

Starting at the end of September the amount of Cu and other feeding elements in the nutrition water in the recirculation pits was controlled weekly. Table 1 shows the progress of the pit water composition with Aqua-Hort® water circuit. Below, the average pit water composition during the entire period is shown -and as an added comparison the pit not using Aqua-Hort® is shown. (Table 1, lowest row).

Unmissable conclusions were the continuous high presence of Cu (1.2 ppm compared to 0.1 ppm without Aqua-Hort®) and the lowered Fe measured value in the nutrition water at the Aqua-Hort® circuit.

After decreasing the set Cu value in the Aqua-Hort® from 1.5 to 0.5 ppm in week 50 we didn't see a decrease in the copper level in the recirculation pit until 3.5 weeks later. This slow reaction was due to the surplus Cu, not absorbed in the plants, being constantly available.

Table 1: Progress composition nutrition water in the Aqua-Hort® circuit

	pH	EC	NO_3	P	K	Cu	Fe
		microS	mg/l	mg/l	mg/l	mg/l	mg/l
Sep 27	5.3	1603	614	79	283	1.0	0.7
Oct 4	5.0	1616	706	77	282	1.5	0.4
Oct 12	5.1	1661	739	80	283	1.1	0.8
Oct 18	5.2	1691	677	84	282	1.3	0.8
Oct 25	5.3	1722	711	90	274	1.8	0.7
Nov 2	5.0	1734	660	84	309	1.1	0.6
Nov 8	5.0	1742	662	85	303	1.2	0.6
Nov 15	5.2	1201	451	58	205	1.2	0.3
Nov 22	4.9	1365	523	66	219	1.3	0.5
Nov 29	4.7	1547	593	74	275	1.4	0.7
Dec 6	4.7	1563	597	76	263	1.5	0.7
Dec 13	4.6	1598	608	73	281	1.8	0.6
Dec 20	5.0	1324	495	60	234	1.4	0.5
Jan 10	4.5	1687	588	80	286	1.2	0.8
Jan 17	4.7	1135	420	54	192	0.9	0.4
Jan 24	4.7	1372	501	53	223	0.8	0.7
Jan 31	4.8	1513	546	51	234	1.0	0.7
Feb 7	5.1	1543	553	48	243	0.9	0.8
Average Aqua-Hort®	**4.9**	**1534**	**591**	**71**	**260**	**1.2**	**0.6**
Average without Aqua-Hort®	**4.8**	**1574**	**608**	**75**	**263**	**0.1**	**1.3**

Progress of copper level in pot soil and in the plant

The composition of the pot soil and the plant of Hedera was controlled at 2 different times (Table 2).

The measured copper level of Aqua-Hort® circuit was clearly increased. The pot soil showed a presence of 0.9 to 3.7 ppm of Cu (compared to 0.2 ppm without Aqua-Hort®)

The leaves showed an absorbed copper level of 15.7 ppm at the end of October; this level still increased to 30.3 ppm which is above the fytotoxicity level; on controlling previously rinsed specimens it seemed to be only 18.8 ppm (60% of this copper) IN found in the leaf; the rest was in the form of residue on the leaf. This was caused by Hedera's-branches being partly exposed to nutrition water with each irrigation during the last growing months. No evidence of fytotoxicity effects at all.

Other elements:

Plants using Aqua-Hort® clearly showed a lower level of Fe both in the plant soil as well as in the plant (antagonism Cu/ Fe). Also Mn showed as a lower level in the pot soil, although absorption in the plant could be compared to plants not using Aqua-Hort®.

Table 2: Copper level with Hedera (in ppm)

	Cu pot soil (mg/l)		Cu in leaf (mg/kg DS)		
Hedera	10/25/04	02/07/05	10/25/04	02/07/05	after rinsing
Aqua-Hort® -circuit	0.9	3.7	15.7	30.3	18.6
Without Aqua-Hort®	0.1	0.2	3.3	-----	-----

'-----' *= not measured*

Also Spathiphyllum was controlled regarding composition in the pot soil and in the plant (Table 3). The measured copper level in the pot soil of Aqua-Hort® circuit was also clearly increased, 3.3 ppm (compared to 0.1 ppm without Aqua-Hort®).

However, the absorption of copper in the leaves was limited; 4.0 ppm in October, 7.3 ppm at the end of the trial period. No evidence at all of fytotoxic effects.

Other elements:

Also with Spathiphyllum plants using Aqua-Hort® circuit showed an obvious less amount of Fe both in the pot soil, and in the plant (Antagonisme Cu/Fe). Mn showed no decreased level.

Table 3: Copper level in Spathiphyllum (in ppm)

	Cu in pot soil (mg/l)		Cu in leaf (mg/kg DS)	
Spathiphyllum	10/25/04	02/07/05	10/25/04	02/07/05
Aqua-Hort® -circuit	-----	3.3	4.0	7.3
Without Aqua-Hort®	-----	0.1	2.3	3.4

'-----' *= not measured*

<u>Plant observation Hedera</u>.

Plant growth: as Hedera produced a lot of tendrils, the growth of the length of the branches as well as the plant weight was studied (Table 4). After 2 months' growth no difference in growth was to be seen, although a slightly improved root development with plants using Aqua-Hort® was visible. From that moment the plants were continually kept over watered (high irrigation frequency). Towards the end of the third month roots not using Aqua-Hort® were experiencing difficulties and after 4 months the effect on growth was obvious, less plant growth and less development of roots; the final measurement showed a rather equal picture. Plants using Aqua-Hort® water circuit clearly experienced fewer problems with the lengthy period of water soaked pot soil; the branch length, the all round growth of the plant above the ground as well as the root growth were obviously higher than those not using Aqua-Hort®.

Loss: Plants not using Aqua-Hort® circuit showed a lot of loss due to root rot, after 3 months' growth 8 %, after 4 months 44% and towards the end of the trial period more than 90% loss. All plants using Aqua-Hort® circuit remained completely healthy.

Fytotoxicity: The plants using the Aqua-Hort® circuit were in a perfect condition. The high copper level in the race didn't show any visible problems.

Table 4: Measuring Hedera

Measuring of	Growing time	2 month	4 month	6 month
Branch length (cm)	Aqua-Hort®	71.1	**101.7**	-----
	Not treated	72.4	87.4	-----
Weight (g/plant) Plant above ground	Aqua-Hort®	17.3	**29.7**	**38.4**
	Not treated	17.1	21.3	30.6
Weight (g/plant) roots	Aqua-Hort®	**2.0**	**6.5**	**7.1**
	Not treated	1.7	5.3	6.5
Loss (% off plants)	Aqua-Hort	0	1	1
	Not treated	0	44	+90

Plant observation in Spathiptyllum.

Plant growth: Both the plant height as well as the development of the leaf and roots (plant weight) showed no positive effect of Aqua-Hort® (Table 5). This might be due to the fact that the artificial water stress (continued since the third month) was not sufficient to make the plants not using Aqua-Hort® sick. The roots of the plants not using Aqua-Hort® remained the same as those using Aqua-Hort®.

The conclusion can be taken that Aqua-Hort® does not give a contribution to a normal race. Only when the infection risk is increased does Aqua-Hort® show its positive usage. It keeps plants healthy and growing.

Loss: Loss to be seen in plants using or not using Aqua-Hort® was negligible

Fytotoxicity: Fytotoxicity was also not visible on the plants.

Table 5: Measuring with Spathiphyllum

Measuring of	Growing time	2 month	4 month	6 month
Branch length (cm)	Aqua-Hort®	-----	43.2	-----
	Not treated	-----	43.9	-----
Weight (g/plant) Plant above ground	Aqua-Hort®	10.3	16.6	20.7
	Not treated	10.5	18.2	22.4
Weight (g/plant) roots	Aqua-Hort®	6.8	9.8	13.8
	Not treated	7.5	10.6	13.9
Loss (% off plants)	Aqua-Hort®	0	0	0
	Not treated	1	1	1

Conclusion.

First trial of Aqua-Hort® usage after the fertilizer mixer showed extremely good results for Hedera, especially a strong all round growth and protection against loss.

Spathiphyllum, to the contrary, showed no positive influence on root development or plant growth. This race showed the absorption of copper on a much lower level than with Hedera; loss was not shown anywhere.

More trials will be carried out in 2005. These can be visited following an appointment by telephone 0032/93539455.

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