

Brooke's Hydro Experiment



First there was water and then there was nutrient. A simple hydroponic school experiment describes how plants feed

~ By Rob Smith

My 13-year-old granddaughter Brooke had to do a project for school and came to ask me what on earth she could do. I thought for a while and not understandably came up with the suggestion that she did something about hydroponic growing. "What about how today's hydroponics got started?"

"Oh yuk," she retorted. "That doesn't sound very interesting."

Well, I thought it did, and I had to convince Brooke that she should give it a go. The challenge was on. First, I had to somehow describe how the whole process came about and then try to suggest some ideas as to how this could

be simplified enough to be sensibly explained in a low-cost project that would hopefully impress the class.

Let's first have a bit of historical background. History records that the hanging Gardens of Babylon were all hydroponic. (Babylon was an up-market town in Iraq.) When one considers the deserts of the Middle East, it is not hard to imagine that hydroponics would be a pretty good way of growing. Working details of how their systems operated is not known, but from many structures that are still left from the old world, we do know that water handling technology was pretty

sophisticated, and that water was transported long distances using nothing more than gravity. Just looking at some of the aqueducts, as the Romans called them, confirms that some pretty good designers and builders were at work in those days, many of their accomplishments challenging the civil engineers of today, so for the ancient Babylonians to also have sophisticated hydroponic growing systems is not that hard to believe.

From a totally different perspective, and on the other side of the Earth we have South America native peoples, who to this day still grow hydroponically in lakes. These lakes are

regularly replenished by mineral rich waters flowing down from the mountains above. The system that has been used since the dawn of their civilization sees them making rafts out of timber and flax. The rafts are covered with a thin layer of soil into which they plant their seeds. The rafts are then floated onto the lake water and as the seeds germinate, their roots find their way through the loosely matted flax, down into the mineral rich water. From there on this natural passive hydroponic system grows their crops to fruition. Simple yet very effective.

While these things had been happening for hundreds of years, like many other areas of knowledge and experience, they were not sensibly recorded or even verbally passed on to the so-called New World.

They proceeded to grow plants in the various liquid compounds they had produced and pretty well established that it was not the actual soil that fed the plants but various mineral elements held within the soil. It was these elements that they had washed out of the soil that actually grew the plants. Over time, the various elements involved were identified until the stage was reached where it was established that plants needed at least 12 basic elements, plus possibly four or more about which little of their requirement is understood even today.

Space does not allow for a full description of how plants work and the general subject has been covered very well over the years by different Growing Edge writers. To simplify: Through the process we call photosynthesis,

when you accept the fact that if it were not for plants producing the oxygen we breathe, then there would not be any other form of life on Earth, just plants.

We have established that the plant makes at least 75% of its own food supply through photosynthesis so the other plus/minus 25% has to come in the form of dissolved minerals through the roots of the plant.

To demonstrate this fundamental aspect of plant growth, Brooke decided to observe plants growing in three kinds of water. The first would be pure water. The second would be a Sachs and Knop soup made by mixing soil and water, and then pouring off the liquid once the solids had sunk to the bottom. This brew would contain an unknown quantity of maybe most of the required elements. This was assumed, because plants seemed to be growing OK in this soil in her garden. Lastly, a set of plants would be grown in water containing a full hydroponic formula containing everything in the correct proportions that the plant needs for healthy growth.

Ready, Set, Grow Hydro

First, some bean seeds were propagated in potting mix. It is important for people to realize that seeds contain all the food that the plant needs to grow to the first set of leaves. We see the small plants growing in Fig 1. Note the seed which has opened and divided down its middle to allow the stem and roots to extend down into the soil and the leaves to grow up towards the light. All the food the plant needs at this stage of growth is contained within those two seed halves. These will eventually be stripped of all their food store by the growing plant and will ultimately wither and drop off the stem.

As soon as the plants were large enough to be safely transplanted, all the potting mix was washed off the roots and the plants transferred into the three hydroponic test gardens. These gardens were placed inside a glasshouse.

The gardens were very simply made by using old ice-cream tubs for the plant contain-



Fig.1

In the late 1800s a couple of European scientists Knop and Sachs were trying to get to the bottom of how plants grew. No doubt they had heard the tales of Babylon and other interesting stories of man-made gardens. They knew that there appeared to be soils of different qualities, and that plants grew much better in rich black soils than they did in poor light soils.

To cut a long story short, they mixed various batches of soil with pure water, stirring each brew for a few days, allowing the solids to sink to the bottom and then decanting the relatively clear water/soil soup from the top.

plants take in carbon dioxide (CO₂) through their leaves and water through their roots and make at least 75% of their own food supply using the energy of light from the sun. At the same time, as a by-product of this process, they produce and release oxygen into the atmosphere that supports all other life on Earth.

For this life-giving reason alone, I think it is pretty important that we know as much as possible about how plants work, especially



Fig.2



Fig.3

ers and some odd pieces of hydro gully were used to support the plants. In Fig2. we see the plants after two days in the test gardens.

While plants provide the oxygen we need to breathe, they also want a small amount back for themselves. The place they need a supply of oxygen is around their roots, so we have to make sure that a constant supply of oxygen is available to them or we will see the roots of the plants start to die and eventually the whole plant will die. Without oxygen to the roots, the plants will drown. To prevent this, we bubble air through the water using an aquarium air pump. These are normally used to provide aquarium fish with sufficient dissolved oxygen for them to live.

Note the air supply pipes which are bubbling air into each of the containers to make sure the roots have enough oxygen to keep them healthy. (A simple experiment is to wrap a piece of tape around your finger for a couple of hours—as soon as you remove the tape you will see that the skin is much lighter in color. And if you hold it to your nose you will find it smells. Reason is that oxygen could not reach under the tape, and in a very short period of

time the surface skin cells begin to die, hence the nasty smell and loss of color. This is a dramatic experiment to show what will happen to the health of the roots if you do not provide oxygen for them!)

Fig 4. shows the hydroponic nutrient being aerated to maintain the roots in a good healthy condition. This is probably the simplest way of growing hydroponically, and plants of any size can be grown just like this as long as you keep up the level of dissolved oxygen in the nutrient. I have grown tomatoes in a 30-liter container to an age of 14 months. The roots at that stage fill the whole container, and with the air bubbling up through them one could imagine them looking like a mermaid's hair

Fig.6



drifting in the water.

As well as making and running the test gardens, Brooke also made up a presentation for the project shown in Fig 5. It sequentially describes the story and includes descriptions of the various stages of the experiment and photographs showing the results. 🍀

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Fig.4

A few days later and we can now see in Fig 3. the difference in growth between, from left, pure water, soil-derived nutrition, and the hydroponic nutrition. The plants in the pure water will continue to survive until all the food that was provided within the seed is used up. The plants growing in the soil brew will continue to grow, but because the nutrition is not balanced and may well be lacking essential elements the plants will not be as healthy as they should be. The plants

Fig.5

