A few new applications in hydroponics.

By William Texier - GHE

As you might well know, the word "hydroponics" covers many different techniques.
Most commercial operations are only pretty basic open systems: the plants are grown on a rockwool slab; a nutrient solution is circulated various times a day according to weather. 25 to 30% of that nutrient solution goes into the ground at each watering. This is made to avoid a salt build up in the substrate. This technique, so damaging for the ecosystem, can be used at best to grow on a large scale tasteless tomatoes and odorless roses.

Our technology, Aeroponics (strictly speaking Aerohydroponics) opens the door to many more applications. This is due to the precise control of the nutriments, the hyper oxygenation in the root zone and the high quality of the plant food. Access to the roots is also an added benefit, offering many new possibilities. In this brief article, I review some applications of aerohydroponics, leaving aside the most obvious one: The possibility for anybody to grow at home their favorite plants!

Access to the roots

This is an interesting aspect of aeroponics. In most medicinal plants, the active principles are located (or are also located) in the roots. In some cases, the ones in the roots are different from the ones in the aerial part of the plant. Impossible to extract them without destroying the plant. As a result, many medicinals are over harvested in nature, sometime to the point of extinction.

Roots to «milk» - Photo PAT

In our closed systems, the roots are bare and soak in a flow of nutrient. In that situation, you can harvest a large quantity of them on an almost continuous base without destroying the plants. Obviously, you have to cut some of the aerial parts at the same time to keep the plant in good balance. In some cases, this green biomass is by itself another source of extraction, other times it is simply composted. When you harvest roots in this manner they are clean, they don't require a wash or any other process before extraction. They are also very rich in active principals. Their concentration can be increased even further by adapting the plant nutrition to the type of molecule that one wishes to produce. Further more, we can increase the growth of the roots themselves by controlling the level of dissolved oxygen in the nutrient solution.
To go from research to large scale production, the first step is to identify a crop that is suited for this practice. It is necessary to have an existing market for the molecules harvested, either extracted, or as roots ready for extraction. In this field, as in all others when it comes to cultivation, it is necessary to secure a market and organize the commercialisation of the product before starting the cultivation. However, in that case it is less critical than with fruits or vegetable since the dry roots can be kept for a long time with no damage.

In our little research greenhouse at G.H.E., we now finished many of the preliminary tests. This growing season will give us the last answers that we need before we can start a commercial operation. Until now, the results are promising. This year our tests are made on African medicinal (mondya whytei, eriosema cordatum, tabernanthe iboga), a European one (arnica montana) and a north American (desmanthus ilionensis)

Taxol roots, in AeroFlo - Photo PAT

There is another way, even more creative, to harvest secondary metabolites (active principals) from a plant without destroying it. Also, it does not require pruning the aerial part. This technique has passed the research stage to a commercial production facility already. The method was developed by a private laboratory, PAT (Plant Advanced Technology) together with a French research institute, INRA (Institut National de Recherche Agronomique). An international patent was secured. The idea is simply to move the desired molecules from the roots into the nutrient solution, then to "harvest" the molecules from the nutrient solution. The developers of this process call it "milking" the plants. The plants are left to recover for a while (and synthesize more molecules), then they are "milked" again. This technique allows an exceptional increase in active molecule concentration, up to about 10 times for some plants.
When time came to go from the lab to commercial production, PAT

selected one of our systems, The AeroFlo, for its greenhouses. The first one is in production in the north east of France. Others will follow, all over the territory to choose a climate according to the plant to grow. A technician will travel around the country for the milking operation. He will then bring the molecules to the company head quarters to be treated and commercialized.
Those 2 techniques, harvesting the roots or "milking" them open new horizons for the farmers. The field of greenhouse production in particular, were there is a need for new crops: existing operations have a hard time to survive without government grand's

Production of a large quantity of biomass

Starting a commercial Aerohydroponics facility requires a large investment in money. This cost cannot be upset by growing most of the traditional green house vegetable crops. However, they are many "niche" crops that can prove extremely profitable. One example will help you understand better:
It is difficult to produce tomatoes and make a profit (without government help), but one can very well grow cherry tomato and make a good profit. Tomato is produced massively in very large operations and it is difficult to compete in the field. Cherry tomato is still a "niche" crop.
To take another example, in California, we started a greenhouse to produce basil. There was a large market for Italian restaurants, and very little local production. The basil field was about 100m2. It produced $8,000 in 3 months, at the peak of production, largely paying back the original investment in equipment. It is the only example that I know of in traditional faming were the equipment paid for itself with one single crop!


Lemon Verbena in a Dutch Pot Hydro - Photo GHE

There is also the possibility of essential oil production. Aerohydroponics produces a large green mass rich in volatile compounds, sufficiently to feed a commercial distillation unit using only a small surface of land. Here again, we have the advantage of a clean biomass, with no pesticides or herbicides whatsoever. This year, we are doing also tests in that field. We want to answer that simple question: Is it more profitable to extract essential oils or to dry the plants, put them into tea bags and sell them for the herbal tea market. The plant chosen for the test are mint and verbena, both already in production.

There are many other possibilities of non conventional crops. One of our clients utilizes aerohydroponics to propagate carnivorous plants at a commercial scale. Another one utilizes it to flower rare plants, difficult otherwise to cultivate outside of their natural habitat. We are going to try this year and the following, a crop of wasabi japonica, the rhizome from which is made the green mustard that goes so well with sushi. This plant grows in streams in a mountainous part of Japan. Few growers want to live in those harsh conditions now a day and the product is scarce. It is a long term test since the rhizomes are grown for 5 years before being marketable!

Cultivation in extreme conditions

One of the very first Aerohydroponics systems that we designed was used by a group of technicians for a mission in West Africa (Sierra Leone). They had to put together a project in a region were the land was so poor and of so bad quality that nothing would grow on it! After a few frustrating attends at creating a vegetable garden, tired of eating only canned foods, they ask us for a system that could produce salads and a few fresh vegetables. Since then, we have participated regularly to similar projects. One of the most memorable is a system for a mission in Antarctica. The cultivation room, igloo shaped, was also equipped with hammocks so that the members of the team could come in turns to relax, get warm and take some light. Of course, there again, the main benefit is to provide fresh staple food, priceless for a long term expedition.


Basil n need of light on Tara - Photo TARA

Currently, the ongoing project is the Tara project. It is a French project of which we are proud to be a small sponsor. A boat is ceased by the ice cap and will derive with it across the pole for 2 years. The goal is to assert the depth of the ice cap in different locations, and use it as a reference to study the speed of global warming and its impact on the North Pole ice cap. (The first findings are frightening!). The boat is supplied, and her crew members changed, every 6 months only; so they packed on board an Aeroflo system to produce a bit of fresh food, but also to provide a play ground for the crew with extra light. Nice change from the long polar nights. This project is one of the most interesting among all the ones we participa-

GHE on TARA - Photo TARA

ted in. The many restrictions created by the situation, in particular the little electricity available for a plant to grow in, made it also one of the most challenging technically. The project has still one year to go, if you are interested, you can follow the progress on Tara's web site (tara.org)

Around the end of the seventies, our technology was created chiefly to feed humans in space. One of the key to leave for a long time in a space station is to be able to grow fresh food on the spot. This application is not yet put in practice, and it will be many years before this happens. In the mean time, here on earth, the possibilities offered by that technology are always more diversified. Aerohydroponics provides an ecological solution to many problems created by over harvesting useful plants. At the same time, it enables man to grow plants for it survival in places were it was until now impossible.