



Tomato plantation. *Source:* Grodan.

The High Tech Greenhouse 'thinks' like a plant

The High Tech Greenhouse 2020 gives you an insight into the greenhouse of the future. Eighteen Dutch and German companies join forces, combining their specialisms to increase production in horticulture while reducing the use of energy and water.

TOMAS GROOTVELD

There is no lack of technical innovations in horticulture. Specialist companies are focusing, often with excellent results, on issues such as improved plant nutrition, water usage, saving of energy, climate control and temperature regulation. This is truly necessary: according to the Food and Agriculture Organisation, there will be 9 billion people to feed by the year 2020. Most of them will be living in urban areas.

But how can you incorporate all these techniques under one roof? And how can you make sure that all those innovations cooperate and amplify each other? These are the questions to be answered by the High Tech Greenhouse (HTG). The HTG Consortium was founded in

2011. It consists of companies from different sectors in the region of Rhine Maas North, complemented by leading national knowledge institutions in this field (see box Floriade Innovation Cluster). Their goal is to improve production using intelligent techniques that make horticulture widely and sustainably applicable. The challenge is to feed the world's growing population while putting less stress on the environment: twice as much with twice as little.

"The Netherlands are leading the way in horticultural technology," says Freddy Dekkers, director of Water IQ, and one of the initiators of this project. "Countries such as China, Mexico, Turkey, and Russia

fly in our horticulturists to build greenhouses and to feed off their knowledge."

Smart greenhouses

The HTG Consortium is developing ways to integrate these techniques and methods intelligently. It is developing a system in which plants receive exactly what they need at exactly the right moment. This increases production and prevents energy and water from being wasted. The HTG enables monitoring and adjusting the growth of plants in greenhouses from a great distance, which in turn enables the development of horticulture in larger cities. In this way, the need for transport is greatly decreased and CO₂ emissions can be reduced.

Floriade Innovation Cluster

The Floriade Innovation Cluster collaborates with regional companies and leading knowledge institutes in the field of horticulture on developing and integrating individual innovations in a new production concept called the High Tech Greenhouse (HTG) 2020. The techniques are being tested and validated in a full-scale experiment in greenhouses near Sunny Tomatoes in Venlo (Netherlands) and Georg Hanka Gartenbau in Kempen (Germany).

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Efficient use of space and restricting transport mileage of fresh produce are not the only ways to ensure a sustainable food supply. Sufficient clean water, or the lack of it, is an endless matter of concern for farmers. Partly owing to climate change, periods of drought or heavy rains can become more frequent. A greenhouse provides a solution to this by bringing water to the plants in a controlled manner and by re-using excess water.

It is currently possible to re-use water several times to irrigate plants in the greenhouse. Freddy Dekkers and his company Water IQ are working on a model in which water can be re-used endlessly. Water IQ specialises in making filters for the food and beverage and the horticultural industries. It was one of the first companies to join the HTG project. "Great amounts of water are wasted in the current process. There is a system within reach in which filters can take out all pollution from the water meaning no water is wasted at all. Furthermore, this prevents fertilisers from spreading into the environment." Modern filters also make it possible to extract substances from the water that decelerate the growth of plant roots. This can help increase the productivity of the plant. The HTG contains innovations for every aspect influencing the growth process of the plant. Smart ventilators provide better climate control in the greenhouse. A new system for temperature and humidity control in the greenhouse uses less energy than conventional systems. This system also helps to reduce moulds and diseases.



New hygrometer by Grodan. Two pins with a sensor penetrate into a mat in which the plant is rooted. The sensor measures humidity and nutrients in the mat.

Source: Grodan

The HTG really mollycoddles its plants. "The greenhouse we are trying to create can almost think for itself," says Dekkers. "We are trying to combine all available knowledge and make it easy to control."

Role of the grower?

One of the most sensational innovations in the HTG is the GPS-guided quadrocopter. It can measure each plant's growth, temperature and humidity. These data are directly sent to a computer. Together with other integrated systems, it can then take measurements concerning water, nutrition and temperature. The aim is to fly this device throughout the greenhouse without a horticulturist having to control it manually.

Less exciting but at least as effective is the use of double glazing in the HTG. Conventional greenhouses use single glazing, which is quite poor at insulating. The risk of using double glazing, however, is that the greenhouse can become too warm and moist. The new system of climate and humidity control can solve this problem. Integrating all these innovations into a properly working complex is called system integration.

All this leads to the following question: will there still be a role for the horticulturist in the greenhouse of the future? "What we are doing with these new techniques is automating the eye of the master," says Dekkers. We combine all knowledge and experience in techniques that accurately monitor the condition of the plants, 24 hours a day, 7 days a week, from up close



A water filter by Water IQ, used by industrial breweries, is adjusted for greenhouse horticulture.

Source: Water IQ

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“These new techniques automate the eye of the master.”

or from a distance. This is impossible for a horticulturist to do. With these new techniques we can monitor plants from a distance and take the right measures when needed.”

But how do you convince a conventional horticulturist to switch to a decentralised method of horticulture? “The main argument is that there will be a decrease in the use of raw materials and an increase in output,” says Freddy Dekkers. “And current horticulture is pretty high-tech. Especially important is the integration of systems. This means growers have to work with computer technology even more. The challenge for technicians is to make innovations interact mutually, make them simple to apply and easy to operate.”

Obviously investments are needed in order to build new greenhouses with double glazing and to establish new water purification systems. The result, however, is a win-win situation. The output is greater because of an increase in efficiency and water is used optimally, with none wasted. The use of fossil fuels is cut by 30%, which saves the horticulturist a substantial amount of money.

A concept version of the HTG will be built in Limburg, near the Floriade grounds. A second HTG will be constructed in the German city of Kempen. The project will continue until 2014 to ensure enough time to measure and analyse results. Visitors to the Floriade can take a virtual look inside the HTG, the greenhouse of the future. ●

Project partners

Region Venlo Floriade 2012 BV *Lead partner*

Companies

ISIS-IC GmbH *Sensor development*

Elektro Limburg BV *Installation techniques*

Grodan (Rockwool Benelux Holding BV)

Substrates and irrigation

Hoogendoorn Automatisering BV

Automation and control

Vostermans Ventilation BV *Ventilation*

Pentair Haffmans BV *CO₂ from biogas*

Intelli-labs Deutschland Ltd. *Gas sensors*

Patron AEM BV *Climate control*

Water IQ BV *Water treatment and irrigation*

Phenospex GmbH *Growth scan sensors*

Doppelbauer Anlagentechnik *Heating systems*

Knowledge institutes

Hochschule Rhein-Waal *Remote control development and biomass development by light*

Wageningen University & Researchcentre *Growth modelling*

Hochschule Niederrhein *CFD modelling and flying sensor platform navigation*

TNO *System integration applied research*

Forschungszentrum Jülich GmbH

Plan-oriented control modelling