

Autonomous crop management systems developing rapidly

‘We can already see the benefits for greenhouse growers’



“An autonomous crop management system enables you to create ideal conditions in each compartment. A setpoint is adjusted when the calculation model says so and not when it suits the crop manager,” René Beerkens (left) says.

It would have happened even without the Autonomous Greenhouse Challenge, but progress would probably have been slower. The fact is that autonomous growing systems are being developed and implemented all over the world. Four Dutch companies leading the way share their vision and expectations.

Almost immediately after the first Autonomous Greenhouse Challenge (AGC) ended in December 2018, challenge partners Delphy and AgroEnergy announced their intention to continue developing and implementing autonomous crop technology. But despite all their optimism and good intentions, their partnership disbanded a few months later. Since then, they have each pursued their own plans.

More accurately and proactively
Rudolf de Vetten, Chief Product Officer at Blue Radix, a spin-off from AgroEnergy, explains: “The joint venture was going well,

but each organisation had its own vision of the best development path and market approach to take. When it comes to crop management, we want to make life easier for growers with premium algorithms. Twiddling the climate or crop knobs is not something crop managers should be wanting to do any more. Technical solutions can already do this more accurately, more proactively, more efficiently and with better results. This is good because it leaves the grower with more time and energy to focus on the strategic aspects.”

Feeding with expertise and data
Current growing methods need to be actively managed by people. Both the timing and the decisions themselves are prone to errors. Cultivation algorithms developed based on crop-specific growth models don't have these limitations. “You just need to feed the algorithm with the right crop expertise based on the variety and the growing strategy and with up-to-date climate and crop performance

data,” De Vetten says. “We have been feeding expertise into our algorithms efficiently and intelligently for seven years now. To begin with, we only did this for AgroEnergy's energy services. Of course, energy management is still one of the focal points. After all, profitability is not only determined by crop yield; you have to take other costs into account too. The algorithms in our Crop Controller service are geared to this.”

Blue Radix is not tied to a grower's existing products, services, specific data platforms or installation partners, he explains. “This independence is greatly appreciated. Customers can use our services however they want, and they retain ownership of their business data. They only pay for our technology and service, which we provide via the cloud, so it is easy to scale up. So if you want, you can start small.”

Ornamental growers following suit
Most of Blue Radix's customers are fruiting vegetable growers, but some ornamental

Continued
on page 12 >



Don Kester: “Less experienced growers can achieve the same results as their experienced colleagues.”

plant nurseries are showing interest in this technology too. The company was pleasantly surprised by the interest in autonomous growing in the Netherlands. “We expected interest to come mainly from North America, Russia and Mexico, where much larger new turnkey projects can be implemented and where cultivation expertise is thin on the ground. We’re pleased to see that Dutch and Belgian companies are happy to take this step too.”

They usually start off with a trial in one or two compartments. Once the system has shown that it works, a wider roll-out often follows in the next crop. Ultimately, the grower has fewer screens to keep an eye on than in conventional cropping and, according to De Vetten, they have very little else to worry about. The control program itself manages the strategic goals (production, grading and quality) in the most efficient way. “We can already see the benefits for greenhouse growers,” De Vetten concludes. “The great thing is that they can see them too.”

Digital ecosystem

Delphy Digital is working on its own digital ecosystem, which is needed to facilitate autonomous growing. Together with a number of colleagues, crop engineers Klaas van Egmond (ornamentals) and Max van den Hemel (greenhouse vegetables) are working on this full-time. “For autonomous growing, you need to collect and analyse crop and environmental data and process it in smart growth and decision models,” Van Egmond explains. “The data comes from existing systems that growers are already using, as well as new systems such as advanced sensors and robots. You can see this as a digital ecosystem serving the plants. They are the focal point and need to be able to perform

optimally and as cost-effectively as possible in your chosen crop strategy.”

Fine-tuned to the local situation

“Part of our task is to use the relevant data flows in growth and control models to optimise the crop locally,” Van den Hemel adds. Climate and greenhouse conditions vary considerably – not only between countries and regions but sometimes even between compartments on a single site. An autonomous crop management system enables you to create the ideal conditions for each separately controlled climate compartment. A setpoint is adjusted when the calculation model says so and not when it suits the crop manager. If a person does this fine tuning, it is usually too early or too late.

Two types of client

The consulting service distinguishes two groups of clients. In Western Europe, with the Netherlands in the lead, growers already have a great deal of green knowledge. The need for autonomous management is not yet that pressing here, although their potential for improving results or scaling up operations is recognised.

“Demand is greatest from abroad,” Van Egmond says. “Digitalisation is one of the key aspects in almost all new projects. The investors behind these projects are not interested in the last 10% gain. They want a guaranteed return based on good and predictable yields. Managing and assisting these companies is easier and more efficient with digital support. It’s also proving to be an indispensable part of our consulting toolbox.”

In research and practice

Although its systems are still under development, Delphy Digital has also started to apply its algorithms. Van den Hemel: “An autonomous growing trial with large cluster tomatoes involving Blue Radix is about to start at our Improvement Centre, and our Japanese research partner is carrying out a cucumber trial. A customer in China has already handed climate control over to the computer completely, and in the Netherlands we are running trials on multiple customer sites. These projects all generate points for improvement and important takeaways.”

“The pace is fast,” his colleague adds. “The market seems to be ready to embrace autonomous crop management, and we can provide that. We expect these systems to be in use all over the world soon.”

Greatest ever innovation

Hoogendoorn Growth Management shares this expectation. On 8 October, the company launched what it claims is its greatest ever innovation: the IIVO all-in-one climate computer. Controls specialist and consultant

René Beerkens: “We have been working on this project in complete secrecy for several years. IIVO is completely new and ready for autonomous growing. And that is summarised in our slogan: ‘Ready, Set, Grow’.”

The new flagship supports both conventional growing methods and autonomous management and decision models. It is fully web-based, works on the principles of Plant Empowerment and can be operated from a PC, laptop or smartphone. Beerkens compares the system to a hall with lots of doors. There are applications and opportunities waiting behind each door. The grower decides which ones to open.

Tested in AGC

Beerkens and a colleague from LetsGrow.com, the data platform with which IIVO is fully compatible, worked together in the team that won the most recent Autonomous Greenhouse Challenge (AGC). “What our teammates didn’t know was that some of the algorithms we used in the challenge were already in this computer,” he reveals. “The challenge was more than just a successful test case. We have also tested the system extensively at a plant breeding company, and it has already been implemented at several of our customers.”

The new computer is the powerhouse that analyses all the data, combines it and, with the aid of growth models and algorithms, translates it into real-time control actions that generate maximum added value for the cropping period and objectives specified. There is a clearly designed dashboard on which the grower can monitor crop status, look ahead (harvest, maintenance and labour forecasts) and adjust setpoints if required. That is not something they will need to do very often, though, because the technology



Rudolf de Vetten: “We have been feeding expertise into our algorithms efficiently and intelligently for seven years now.”



According to crop engineers Max van den Hemel (left) and Klaas van Egmond, autonomous crop management and remote cultivation support go hand in hand.

can do it better, faster and more efficiently than a person can.

Training programme

The principles of Plant Empowerment form the backbone of the calculation models. Beerkens: “In each of our test cases, we formulated a Growth Plan based on growth models and this cropping method and fine-tuned it to the cultivation goals and conditions inside and outside the greenhouse. This requires a certain degree of insight and skill. To support the roll-out of our new product we have also developed a training programme which covers Plant Empowerment and autonomous growing. A team of ten expert trainers will be delivering this over the coming months and years.”

Strength in simplicity

During the GreenTech event on 20 October 2020, Priva launched its autonomous growing technology, Plantonomy. This digital service is designed to simplify consistent crop development. “It adds horticultural knowledge to the greenhouse data and uses artificial intelligence to further improve the model. The algorithm controls transpiration following the natural biorhythm of the plant,” Priva’s Don Kester explains.

Although the grower still has an overall picture, there are far fewer settings to adjust to achieve predictable crop results. “The system excels because of its simplicity,” says Kester. “With Plantonomy, less experienced growers can achieve the same results as their experienced colleagues. Growers don’t have to spend so much time at the computer, which significantly extends the scope of their crop management work. During the day, users get

to see an active climate and don’t have to intervene, even if the weather changes suddenly.”

Biorhythm

Settings are automatically adjusted to meet the crop’s needs, with the biorhythm (growth model) determining what can and can’t be done. For example, roses can be allowed to grow more generatively for a while to produce more blooms for cutting in time for Mother’s Day, but after that, the plants need to regain their strength.

Kester: “It takes a lot of expertise and complex calculations to make that happen, but we don’t want to burden the crop manager with all that. They should be able to manage the crop even if they don’t have that much experience. Reputable growers in the Netherlands and elsewhere have found that it works and are now our first paying customers.”

Summary

The green IT sector is working intensively on further developing autonomous growing systems in which growth and calculation models, or algorithms, are responsible for the actual crop management. These models are fed data on crop development and the climate conditions inside and outside the greenhouse 24/7. Because this reduces human error, it is highly likely that autonomous growing will deliver better crop and operating results. Fruiting vegetable growers are already using these systems.



Sprung

Spring has very much sprung and, in my opinion, has it the worst of all seasons. I don’t mean in any way that it IS the worst season, just that it has the hardest time. I’m sure everyone has their favourite season: autumn with its range of colours and signs of change; winter with festivities and woolly jumpers; and summer with the promise of holidays, outdoor adventure and glorious weather.

The start of spring, however, varies for us all. Signals could include the new budding of trees, the migration of deer, the longer day lengths or many other factors, but the change from winter to spring is fraught with the highest expectations year upon year. We seek an immediate end to the coldest snaps of weather and heaviest rain and hope that every day is a warmer, or at least a milder change from the last and the hint of sunshine brings hope for better climates.

People discuss the long, drawn-out evenings of spring and make plans to complete tasks carried over from the winter, but rarely do the brighter mornings appear.

For me, the spring promotes growth. With plants sprouting outdoors following the winter, providing food and habitat for animals formerly in hibernation, the landscape is waking up. The smell of pollen outside, the colour-changing landscape and the increase in birdsong in the air tells me that once again nature is back to work, and so are we.

Despite the extremities of the weather we have already experienced this spring, such as snow, gale-force winds and bright sunshine, our plants in the greenhouse also react to the changing season naturally regardless of the climate-controlled environment we set. As growers, we play a small part indeed, but the small changes of a shortening night period and the height of the sun every day require constant supervision and if managed correctly, we can benefit massively from them.

As production slowly increases and we look forward to the longest day length at the end of springtime, it is important to understand that our crops will also experience these changes.

John Cappalonga
Pepper grower at Gee Vee Enterprises, UK