Part 1 - The start of data-driven growing

Whitepaper

Grodan®

Part of the ROCKWOOL Group

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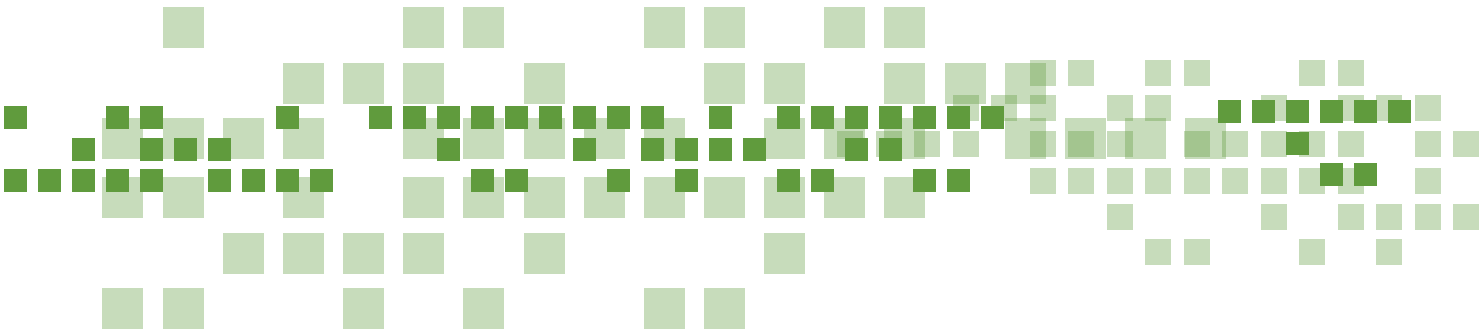
Introduction

High-tech greenhouse horticulture is preparing for a new, global transition to data-driven growing practices. In Horticulture 4.0, countless sensors and measuring systems collect a constant flow of data on growth conditions and the functioning of crops, from both visible parts of the plants as well as in the root zone environment. These multiple data flows and their correlation are analysed centrally and translated real-time into setpoints using sophisticated growth models and smart, self-learning software. The recommendations can be used to maximise the expected operating results. This is the ultimate form of Precision Growing.

Data-driven growing will certainly not make growers redundant, but instead will help them to maintain a clear overview and take better-informed management decisions. Upscaling in horticulture continues unabated, and growers often operate on multiple production sites, which will have to be managed by fewer people with the necessary expertise of cultivation practice. In this scenario, advanced technology is vital.

In this document respected researchers, innovation experts and the people at Grodan involved in these developments outline the importance of data-driven growing. What does it promise, how does it work and what impact is this new phenomenon expected to have on the functioning and organisation of horticultural companies? Grodan's management and team hope that their reflections, vision and insights will contribute to a better understanding and inspire you to push boundaries together. Enjoy the read!



Chapter 1
The next step in Precision Growing

With *Vincent Deenen*

When I fly home from a trip abroad and my plane descends above the Netherlands, that wonderful panorama of greenhouses, often hundreds of metres long, unfolds below me. The pride of our nation. Hyper-modern centres of production where motivated growers passionate about their craft, grow beautiful, top quality crops every day. But their task is not as smooth as it might seem. The sector is threatened by a chronic shortage of labour. Production cycles have to be faster and cheaper. That makes it difficult for growers to commit to agreed volumes, prices and delivery dates.

Data silos
Consequently, operational processes in the sector need to become increasingly smarter. Similar to other sectors, the role of big data in this respect is undeniable. However, this essential data is often complex and found in fragmented data sources in the form of diverse isolated systems used in greenhouse horticulture. The data is in fact collected in various data silos, which restrict growers from gaining full insight. For example, fewer opportunities for analysis, more complicated predictions and a weaker negotiating position in trading channels.

Combining data smartly
With these challenges in mind, we have been working recently with our developers and forward-looking growers on a new, open, web-based platform. Our shared aim was to combine and analyse the multiple data flows to create a single, easy-to-use interface. We call this platform e-Gro.

Transition in growing
e-Gro actually represents the beginning of an exciting new transition: from soil-bound growing via 'growing media solutions' to smart solutions for data-driven growing. This development is an integral part of the objective of achieving maximum output with minimum input: Precision Growing. But in this case refined and digitised further. This system facilitates 24/7 management of horticultural companies using an open software platform. We are on the threshold of further far-reaching digitisation of the sector.

Big data and Horticulture 4.0
Terms such as Horticulture 4.0, big data, machine learning and AI are quickly becoming familiar parlance in the horticultural industry. A number of growers already use e-Gro or are gaining experience with it. The initial responses are positive, which gives me an impulse and energy to continue.

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Chapter 2
Data-driven growing is vital

With *Paulina Florax*

Making the best growth strategy choices based on reliable data is often still very challenging for entrepreneurs. After all, collecting data is one thing, but interpreting and applying it is quite a different matter. Horticultural entrepreneurs are facing a massive challenge. While demands placed by the market are becoming increasingly stringent, increasing digitisation cannot be ignored. The underlying precondition for continued success in the future is anticipating and embracing these developments. Making the right decisions at the right time has never been as critical as it is today. But how can growers ensure they have the right information on the one hand and know what to do with that information on the other?

Specific advice

Grodan, supplier of stone wool substrates, is one of the founders and initiators of 'precision growing'. For years, Gordan has committed to helping growers create optimal growing conditions in greenhouses. Not just by developing high-quality stone wool substrates, but also by ensuring that using these resources results in optimised yields. This includes the market launch of various sensors. The latest development in this history of innovation is e-Gro: a digital platform that collects relevant data and translates this real-time into specific advice and recommendations for growers.

Insight into growing

"Our expertise is in the area of substrates and root zones, but there are so many other factors in the greenhouse that impact crop growth," says Paulina Florax, Product Marketing Manager e-Gro. "For instance, the climate, energy and irrigation strategy. To make all these parameters transparent, we have developed a software platform in the form of e-Gro that other parties can participate in. All aimed at providing growers with objective, clear advice that factors in all parameters of growth." Grodan introduced the e-Gro mobile app some years ago. At the time its focus was limited to the root zone environment. "Fuelled by the experience we gained in practice, e-Gro has been expanded and we have opted to widen the scope. The new platform is able to combine data generated by various sources, including climate control computers.Based on this, the e-Gro team can quickly provide specific advice on how to refine the growing strategy."

> Data-driven growing is gradually becoming essential, because of the complexity of issues facing growers.

Data-driven growing

"Growers all over the world already use e-Gro and features are regularly added or refined in the software platform in response to their experiences and recommendations. So, in fact, e-Gro was developed with the input of and by growers. These users report very positive reactions," says Florax. "Data-driven growing is gradually becoming essential, because of the complexity of issues facing growers. Through e-Gro, we want to make this process as frictionless and easy as possible. We are also happy to collaborate with other parties in the sector to optimise the platform in the best possible way. Because the more data we can unite from various sources, the more precise the growing process."

Chapter 3
Towards an autonomous greenhouse - part 1

With *Leo Marcelis*

Optimising the performance of their crops is an integral part of the daily tasks of growers and propagators. Many growers frequently utilise the expertise developed at Wageningen University & Research. As a professor and head of chair group Horticulture and Product Physiology, Leo Marcelis is an expert on how plants grow, their response to environmental factors and how targeted growth strategies can be applied to steer crop development.

Data-driven growing is one of the themes he is currently researching. We spoke to Leo Marcelis and asked him about his research and his perspective on the data-driven greenhouse of today and tomorrow. Various sensors are installed in the greenhouse for data collection.

How do you see these developments?
In his office at Wageningen University, Leo talks about the enormous volumes of data that growers will have to deal with: "We already studied sensors in the greenhouse 20 years ago " says the professor. "Back then, the number of sensors was still limited. But in the intervening period, sensor technology has evolved rapidly. We noticed that growers lacked the specific skills necessary to cope with this way of working. But it was already evident that data could be used to grow better crops. Today, growers have a greater degree of control of their production systems, and practically every grower embraces the potential offered by technology. They install larger numbers of sensors and perform more measurements themselves. But although you might have a lot of data, all that information doesn't necessarily mean you have more knowledge."

How do you convert data into knowledge?
"The information has to be combined and converted into smart algorithms. e-Gro is an example of a tool that makes this possible. Autonomous control in greenhouses is a development that is on the increase, and more and more tasks are being automated. The ultimate goal is a fully autonomous greenhouse where production is controlled by a process computer. As part of our own research we are conducting trials so we can learn how to turn this into a reality in the future."

> We already studied sensors in the greenhouse 20 years ago.

Chapter 4
Towards an autonomous greenhouse - part 2

With *Leo Marcelis*

Data in the greenhouse is an increasingly key tool to optimise crop performance. In chapter 3 'Towards an autonomous greenhouse' Professor Leo Marcelis spoke on the increasing use of data and measurements for growers. This chapter zooms in on these data-driven developments in the horticultural sector, which improve the quality of tomatoes, sweet peppers and cucumbers and open up opportunities for growers in the future.

Data gives growers more control in the greenhouse.

Why would a grower want to use all that data?
"Data gives growers more control in the greenhouse. Growers are under pressure to produce more, but higher production has to satisfy a number of factors. For example, efficient production but in a sustainable way, without using pesticides. Some twenty years back, we already picked up signals of ever increasing demands regarding the environment. Today, virtually the entire sector subscribes to the necessity of sustainable growing practices. This concerns the actual process of production. However, data-driven growing also improves the quality of the final yield: the appearance of the tomato, its taste, and enhances the nutritional value of the tomato."

What role will a grower still have in an autonomous greenhouse?
Leo emphasises the value of the grower, but also the growing role of technology: "The need for growers to embrace and evolve along with these new forms of technology became apparent during the Autonomous Greenhouse Challenge in 2018. The challenge involved five teams - often without a grower - who had to grow cucumbers remotely from September to December. At the same time, they had to compete against a grower who could do his work as usual in the greenhouse. The challenge was which team could achieve the highest output. To everyone's surprise, it wasn't the grower who had the highest production, but a non-grower who triumphed based on data. A grower's specialist knowledge will continue to be vitally important in practice, but growers will also need to adapt if they don't want to be overtaken by advancing technology."

What opportunities does data-driven growing offer growers?
"You can see interest growing in new technologies such as data management platforms that growers can use in the greenhouse," says Leo. "The scale of companies continues to increase, and upscaling implies new challenges. Machine learning, Artificial Intelligence and more technologies of this kind can provide an answer. And, relocating and expanding operations abroad is becoming a more realistic option for growers too: data systems make it possible to run the company completely remotely from the Netherlands. So data can undoubtedly literally expand the horizons of enterprising horticultural entrepreneurs."

Grodan supplies innovative, sustainable stone wool media solutions for the professional horticulture sector, based on Precision Growing principles. These solutions are applied for the cultivation of vegetables and flowers, such as tomatoes, cucumbers, sweet peppers, aubergines, roses and gerberas. Grodan offers stone wool substrates together with tailor-made advice and innovative tools to support Precision Growing and therefore facilitate the sustainable production of healthy and safe and tasty fresh food and products for consumers.

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