

Irrigating high-tech greenhouse grown strawberries

Steerable





Picture 1. Ebb-flood propagated strawberries at Wageningen University and Research (WUR) (2023).



Picture 2. GroSens sensor in a block on an ebb-flood bench during propagation of strawberry.

The way high-tech, greenhouse-grown strawberries are irrigated in propagation and cultivation differs little from that applied to table-top systems. Why?

Thankfully there is another way of thinking

Grodan stone wool growing media is steerable. This permits propagators and growers to exert maximum control over water content percentage (WC%) and electrical conductivity (EC) in the growing media. High-tech strawberry propagators and growers can use these properties to structure their irrigation strategies in order to improve young plant quality and yields. This can be realised using the same basic principles used for irrigation management as, for example, in growing high-tech greenhouse tomatoes.

Irrigation management in high-tech strawberry propagation

The quality of young plants destined for cultivation in high-tech greenhouse can be improved by bringing the whole process of propagation under glass using ebb-flood irrigation systems. As a result high-tech greenhouse strawberry growers, who ultimately receive these young plants will see dramatic improvements in yield. With total control in propagation the moment of irrigation can be timed to perfection. Irrigation EC can be manipulated to influence plant development. Plant quality can be further improved as ebb-flood irrigation systems naturally maintain dry crowns, meaning *Phytophthora* infections are all but eliminated. (Picture 1)

In our trials we have been using greenhouse grown tips. When delivered to our propagation facility the tips are transplanted directly into Grodan stone wool blocks

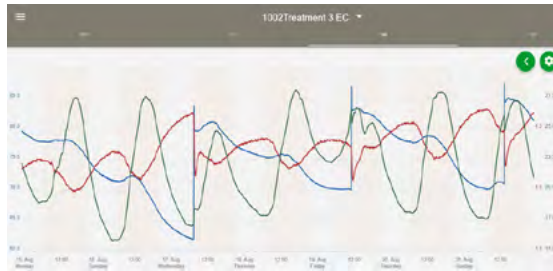


Figure 1. GroSens graphic illustrating the result of a structured irrigation strategy over a period of 7 days for cv Favori grown in a trial Wageningen University Research 2022. Blue line = WC%, red line = EC and green line = temperature of the growing media.

which have been saturated with water containing complete hydroponic nutrient solution at EC levels varying from 1.0 up to 4.0 mS/cm. Following transplanting the moment of subsequent irrigation is then delayed until the block WC% hits a defined target. In our trials these are defined as minimal (60%) or maximum (40%) level. These principles are exactly the same as those implemented by high-tech tomato propagators.

The development of WC% and EC in the blocks is visualised using data provided by our GroSens sensor (Picture 2 and Figure 1). Each irrigation moment (blue line) re-saturates the block back to a WC% \pm 85%. There follows a slow and gradual decrease before the next irrigation is triggered. Irrigating in this way steers plant development and creates an excellent root system within the block. Moreover, ebb-flood irrigation ensures the crowns remain dry. This reduces the risk of diseases such as *Phytophthora*, further increasing the production potential for the upcoming cultivation.

Irrigation management in high-tech strawberry cultivation

Grodan growing media solutions are modular. As such Grodan propagation blocks integrate perfectly with Grodan slabs (Picture 3). The slabs are first saturated with complete nutrient solution 24 hours before the plants arrive from the propagator. The blocks are placed onto the slabs and an irrigation dripper is inserted into each block. Roots quickly grow out of the block and into the slab. Once roots are in the slab the [GroSens sensor](#), inserted into the side of the slab will once again provide real-time data on the WC%, EC in the growing medium (Picture 4).

Picture 3. Grodan block slab system for the cultivation of strawberries.



Can we steer plant development using a structured irrigation strategy during cultivation?

There are some basic principles regarding irrigation that are important to keep in mind when growing strawberries in a high-tech greenhouse. These are the same basic principles and way of thinking used in the cultivation of high-tech tomatoes.

Picture 4. GroSens sensor in Grodan slab.



1. The set-points on the process control computer should be structured such that irrigation start and stop times and the volumes and frequencies with which it is applied, takes account of variable weather conditions.
2. That drain is not our goal within the overall strategy, rather it is the result of using a structured approach to applying irrigation. Indeed on some days we may not require any drain.
3. EC in the growing media (where the roots are) should be lowest when the radiation is highest.
4. That we should aim for stability of WC% and EC in the growing media over consecutive days despite changing outside weather conditions.
5. That we can also steer the generative or vegetative plant balance and protect root quality using a structured irrigation strategy to maximise production.



The principles and approach to irrigating greenhouse tomato adjusted towards greenhouse strawberry cultivation

	Generative	Vegetative	Range Tomato	Range Strawberry
Start time rel. sunrise	Later	Earlier	+4.0 to +1.0 hours	
Stop time rel. sunset	Earlier	Later	-5.0 to -1.0 hours	
EC drip mS/cm	Higher	Lower	4.0 to 2.8	3.0 to 1.8
EC slab mS/cm	Higher	Lower	8.0 to 3.5	4.5 to 2.5
Irrigation volume as % growing media volume	Higher	Lower	6.0 to 3.0	
Irrigation frequency # per hour	Lower	Higher	2.0 to 6.0	
Decrease WC% overnight	Higher	Lower	12.0 to 6.0	8.0 to 4.0

Table 1. Principles and approach of tomato and strawberry irrigation.

An example of this way of thinking illustrating the 'ranges of operation' for either generative or vegetative steering is shown in Table 1.

Way of thinking demonstrated successfully in our trials process in traditional and crops under LED lights.

Implementing these principles provides and the stability they provide in the root zone for strawberries grown in high-tech greenhouses is shown in Figure 2. The blue line indicates the WC% the red line EC and the green line indicates the temperature all within the growing media. You can clearly see bright days and dark days indicated by the change in temperature but what is important to note is that over the duration of 7 days the root zone WC% and EC as well as decrease over night remains stable.

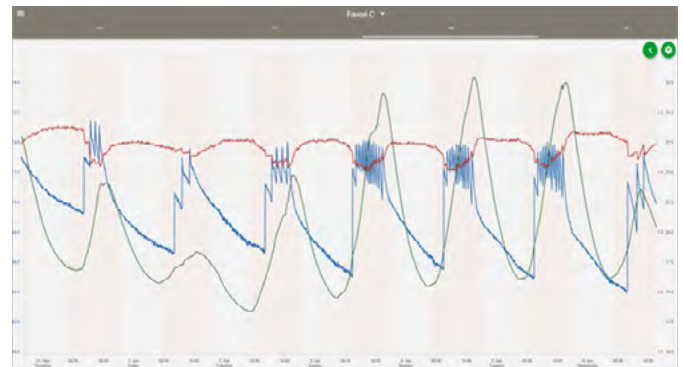


Figure 2. GroSens graphic illustrating the result of a structured irrigation strategy over a period of 7 days for cv Favori grown in a trial Delphy ISFC 2022. Blue line = WC%, red line = EC and green line = temperature of the growing media.

Designed to grow

Grodan is the global leader in supplying [soilless rootzone management solutions](#) for Controlled Environment Agriculture. These solutions are applied to the cultivation of vegetables and flowers, such as tomatoes, cucumbers, sweet peppers, egg plants, roses and gerberas.

At Grodan, we aim to help feed and treat the world's growing population by innovating solutions from our stone wool growing media to enable 'more-with-less' growing. Through the method known as out-of-soil, our [stone wool substrates](#), [sensor systems](#), [software](#) and [expertise](#) support the reliable, informed growing of healthy, fresh, high quality produce. Our material is 100% recyclable, and supports growing methods that use up to 50% less water, 20% less chemical plant protection products and 75% less land. Sustainability plays a prominent role within Grodan, from manufacturing stone wool substrates to [creating recycling solutions and services](#).

Grodan has more than 50 years of cultivation experience. We pioneered the development of hydroponic growing methods in the 1960s, and today, our soilless rootzone management solutions are used in large-scale commercial greenhouses and indoor facilities in over 70 countries across the globe. The head office is located in Roermond, the Netherlands.

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