The New Way of Growing

The concept behind ‘The New Way of Growing’ is to reduce the amount of fossil fuel used in the production of greenhouse tomatoes and thereby make the cultivation more profitable and at the same time, more sustainable. The goal at the start of the cultivation was to realise a production of 63.0 kg/m² using 22-25 m³ natural gas (note the average energy consumption required for producing a tomato crop in Netherlands is 40 m³).

Energy reduction was achieved by using movable energy screens. A double XLS 10 REV was installed above the roof trellis and a XLS 10 REV H2no installed below the roof trellis. Beneath this screen a XLS Harmony REV was installed for use only in summer with the aim of increasing the amount of diffuse light entering the crop canopy.

The screens allowed the maximum pipe temperature to be limited during winter. The 24-hour temperature strategy was adapted to rely more on ‘free energy’ from the sun, compensating for the higher plant temperature during the day by lowering the pre-night temperature set point.

There was no minimum pipe temperature for humidity control. Instead, humidity control, when required, was achieved by ‘active dehumidification’, a process that mixed cold outside air with warm greenhouse air. Distribution of the dehumidified air within the greenhouse was achieved using plastic tubes located beneath the hanging gutter (see image opposite).

Now in its third year, the trial has now focused in 2013 on gaining a better understanding of the relationship between climate [energy] and root zone management strategies, and specifically how the later should be adapted to compensate for the lower energy input and the resultant ‘passive’ greenhouse climate.

Crop steering from planting to flowering third cluster

The variety Capricia grafted to Maxifort was delivered as a 66-day-old plant. They had been pinched on the second true leaf and were therefore naturally ‘open and generative’ when they arrived home at the Improvement Centre on 10 January 2013. On arrival, the young plants were planted directly onto GRODAN Grotop Master slabs, which 48 hours earlier had been saturated with a complete nutrient solution to an EC 4.0 mS (Picture 1)

The initial head density 2.2 m² was increased to a final stem density of 3.3 m² in week 8. This was a conscious and informed decision made using the innovative crop management program from GreenQ called ‘Green Scheduler’. The program calculates the maximum possible fruit load relative to the available light. In this way the timing of the extra shoots can be optimised.

“Making important and informed decisions using the Green Scheduler ensures that crop growth remains controlled and strong,” says Piet Hein, Head Grower at the Improvement Centre.

Throughout the cultivation cycle the strategy was to optimise crop development, yet be as efficient as possible with energy consumption. The maximum pipe temperature during this phase of growth, despite the cold outside weather conditions was 60°C. A ‘generative’ 24-hour temperature
Aligning the irrigation strategy

"From the outset, with such an intense screening strategy in place, the watering strategy needed to be adapted. The extent of the steering would be a true test of the design features of the GROdan slabs as well as our knowledge," says GROdan’s Andrew Lee.

After placing the plants onto the Grotop Master slabs, a small drain hole was made in order to ‘pre-drain’ it strategy incorporated a ‘steep and deep’ pre-night setting and a strong radiation influence during the day (Figure 1).

The double XLS 10 REV and XLS 10 REV H20 (Figure 2) were operated on a relative temperature difference (i.e. the difference between the greenhouse temperature set point and measured outside temperature). This was further influenced by outside radiation and temperature conditions (i.e. if it was cold and dark, they remained closed for longer). The XLS 10 REV H20 was closed first and opened the following day, a strategy that maximised energy saving and light interception (Figure 1).

"The plan is to use the XLS 20F-Harmony REV only if light intensity >600W/m²," says Piet Hein.

"In this way during late spring and summer we hope to increase the amount of diffuse light entering the greenhouse and thereby reduce the stresses on the crop.”

Active dehumidification meant there was no need for a minimum pipe influence for humidity control. Dehumidification was only used if the humidity deficit (HD) difference between the greenhouse temperature set point and measured outside temperature). This was further influenced by outside radiation and temperature conditions (i.e. if it was cold and dark, they remained closed for longer). The XLS 10 REV H20 was closed first and opened the following day, a strategy that maximised energy saving and light interception (Figure 1).

Active dehumidification meant there was no need for a minimum pipe influence for humidity control. Dehumidification was only used if the humidity deficit (HD) during the pre-night was ≤1.2, during the night >2.0 and during the day >3.5 (Figure 2).

Aligning the irrigation strategy

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In the early stages of the crop, applying too much water is negative for plant balance and cluster quality. Moreover, irrigation were stopped. The substrate WC had been the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from the drain silo, which was equivalent to 6m³ water per ha from

Further information

If you would like additional information in respect to sustainable greenhouse cultivation and specifically the trials work of the Improvement Centre and Grodan, please direct your questions to info@groden.com.

Table 1: Overview of the outside climatic conditions, screen hours and water use from planting to flowering of the third cluster.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sunny Day</th>
<th>Cloudy Day</th>
<th>Rainy Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>28.5</td>
<td>22.3</td>
<td>16.5</td>
</tr>
<tr>
<td>Humidity (°C)</td>
<td>80%</td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td>Wind Speed (m/s)</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Solar Radiation (kWh/m²)</td>
<td>6.5</td>
<td>3.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Piet Hein agrees: “Water management is a key component of the cultivation cycle; it is why we are working with GRÖDAN. In the early stages of the crop, applying too much water is negative for plant balance and cluster quality. Moreover, irrigation were stopped. The substrate WC had been increased and a step closer to achieving the emission targets in respect to the European Water Directive 2010.

The aim for Piet Hein moving forward is to slowly decrease the substrate EC and raise the WC in line with the increasing fruit load.

“This does not mean ‘flushing’ the slabs,” says Andrew. Pieter Hein adds: “I shall reduce the dripping EC to 3.5mS, then to 3.2mS as the weeks progress. The aim is a slab WC of 65-70% with an EC of 5.0mS by the time the crop is harvesting. However, the start time of irrigation will be relatively late and the stop time will still be relatively early in line with screen opening and closing.”

This will ensure generative crop development continues and will also help protect root quality as the fruit load increases. For this, Piet Hein is relying on the excellent irrigation efficiency of the Grotop Master slabs, which will allow him to keep a stable and controlled EC with minimal drain volumes.

Part 2 in this series will focus on crop steering to first harvest.

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