



### **Dalsem X-AIR Sustainable Greenhouse Solution**

The X-AIR greenhouse is capable of using ambient physical properties to generate optimal indoor conditions based upon the Data Driven Growing Strategy, with minimum use of energy. This enables the highest yield and quality of crop in the shortest time. Current horticulture demands new sustainable and energy-efficient cultivation techniques and solutions. The X-AIR greenhouse focuses on plant balances to boost plant and crop growth by optimizing the greenhouse and its climate conditions in a sustainable way. The unique Dalsem X-AIR Sustainable Greenhouse Solution is powered by Dalsem (hardware), Hoogendoorn Growth Management (automation) and LetsGrow.com (DataHub). The collaboration between these innovative companies enables growers to optimize their yield in a sustainable manner.

### **Less energy, less risk, more production**

The new X-AIR Greenhouse includes the X-AIR Ventilation System. This Dalsem invention is an essential part of the energy-efficient climate control system. A solution that combines decentralized forced air ventilation and circulation to resemble natural airflow from above to the crop. By circulating and mixing greenhouse air with outside air or air from above the screens, optimal growing conditions are created inside the greenhouse. A practical and compact ventilation system which is strategically placed to cover the entire greenhouse.

Additionally, the decentralization of the controlled outside air intake facilitates growers to cool and/or dehumidify the greenhouse air in an energy-efficient way. The active climate control technology ensures that less ventilation is required and high carbon dioxide (CO<sub>2</sub>) levels can be maintained for a longer period of time. This will translate directly into a substantial production increase and reduction of energy costs. The X-AIR Greenhouse will provide the optimum ratio of temperature, CO<sub>2</sub>, humidity, PAR-light and air movement to result in an optimally performing greenhouse.

### **How the X-AIR Greenhouse boosts plant growth:**

- ✓ Creates air movement around the plants
- ✓ Improves homogeneity of the (micro)climate
- ✓ Maintains high CO<sub>2</sub> concentration
- ✓ Dehumidifies energy-efficiently, whether screens are opened or closed
- ✓ Reduces energy use and emissions
- ✓ Real-time insight into plant conditions

### **The X-AIR Ventilator (*patent pending*) takes ventilation to a new level**

The X-AIR Ventilator is especially designed to mix the required amount of outside air or air from above the screens into the greenhouse. Similar to the conventional airing windows, the X-AIR Ventilator creates a horizontal, equally proportioned air intake throughout the greenhouse area. This ventilation system allows the use of single or double screen systems without limitations on opening and closing.

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### **X-AIR Ventilator benefits:**

- ✓ Forced ventilation with outside air
- ✓ Forced ventilation with air from above the screens
- ✓ Decentralized ventilation system
- ✓ Modularly expandable with heat exchangers and/or humidifiers
- ✓ Operable with screens open or closed

The X-AIR Ventilator uses the proven Airmix ventilator (patented by Van Der Ende Groep) as foundation for the X-AIR Ventilation System. The air-inlet duct is designed by Dalsem and fitted with two mechanically linked valves. This mechanism enables to switch between ventilation by outside air or above screen air. The ventilation system is fully integrated in the greenhouse cover. The duct is fitted between the glass roof panel and the trellis girder. The screens are adapted to ensure a perfect fit around the duct. The X-AIR Ventilator can be expanded modularly with heat exchangers and/or humidifiers. With the heat exchanger fitted into the X-AIR Ventilator, recirculated air or outside air can be cooled and sensible heat can be regained. Depending on the local climate, these additional options accommodate the optimum greenhouse climate for the crop under practically all circumstances.

### **Data Driven Greenhouse**

As part of the new Dalsem X-AIR Sustainable Greenhouse Solution, the Data Driven Growing Strategy determines optimal growth conditions. The two packages for Data Driven Growing are the Professional package (1), which can be extended with the Advanced package (2). The Professional package will be your starting point, using a combination of subsystems for climate control powered by Hoogendoorn Growth Management and LetsGrow.com. This partnership enables Dalsem to offer growers integrated data-driven solutions for realizing sustainable greenhouse crop production by maintaining the plant balances according to the Plant Empowerment principles (GPE).



The strength of the Data Driven Growing Strategy is the combination of algorithms based on greenhouse-generated data, plant physiology and Artificial Intelligence (AI). The strategy consists of a three-step approach: (1) Knowledge Transfer (2) Learning by Doing (3) Implementation and Integration. A person-independent platform ensures continuous access to all accumulated knowledge and data within the company. At the core of the Data Driven Growing Strategy are LetsGrow.com training sessions and data analysis to achieve round-the-clock insights into the limiting factors of the cultivation process. As an additional option, the Advanced package includes extensive training sessions and implementation of all results and data analysis within a three year timeframe. This will lead to automated climate control and optimized water management of the greenhouse. Data connections with robots will be made available by LetsGrow.com. An all-in-one software solution is included in the package developed by Hoogendoorn Growth Management in order to manage and control your Data Driven Greenhouse.

Specific configuration of these subsystems depends on local climate conditions and crop demands. These configurations are available within the two Dalsem Data Driven packages:

### **Professional package**

- ✓ Dalsem X-AIR modules, e.g. X-AIR Ventilator
- ✓ Customized X-AIR Dashboard
- ✓ LetsGrow.com GPE modules, e.g. basic plant conditions & Relative Humidity
- ✓ Plant Empowerment book & e-learning tools
- ✓ LetsGrow.com App, e.g. pest & disease registration
- ✓ Internal communication through chat functionality

- ✓ Sensors, e.g. Thermoview, PAR-light
- ✓ Smart cameras
- ✓ Training based on Dalsem X-AIR Dashboard
- ✓ Training on how to use the principles of GPE in practice
- ✓ Weekly online training & monitoring by LetsGrow.com

### **Advanced package**

- ✓ All features of the Professional package
- ✓ Data Driven Growing: climate & water
  - Designated three-year timeframe
- ✓ Data Analysis, e.g. Light Use Efficiency
- ✓ Target Lines Analysis
- ✓ Data connections with robots
- ✓ Extensive training sessions by LetsGrow.com
  - Data Driven Growing & implementation of Plant Empowerment principles

### **Benefits of the Dalsem X-AIR Sustainable Greenhouse Solution**

With the Dalsem X-AIR Greenhouse, Dalsem offers an improved cultivation method. Benefits of the Dalsem X-AIR Greenhouse include cost reduction, improved energy-efficiency and maximum yield with less risk, minimum inputs and minimum waste.

### **General benefits**

- ✓ Forced air ventilation instead of natural ventilation (semi-closed solution)
- ✓ Higher yield and improved quality products due to optimum climate and higher average CO<sub>2</sub> level
- ✓ High return on investment
- ✓ Standardized processes & increased control for growers thanks to the combination of knowledge and data
- ✓ Longer cultivation period in challenging climates
- ✓ Better space utilization, no loss of cultivation space & no restrictions on the crop production workflow
- ✓ No light emission when ventilating with screens closed
- ✓ Overpressure in the greenhouse ensures steady climate control and reduces plant disease incidence
- ✓ Protection against pests optional by insect netting
- ✓ Protection against spreading pests, due to decentral ventilation
- ✓ Suitable for all types of crops e.g.: vegetables, fruits, flowers or potted plants
- ✓ Suitable for all crop production methods
- ✓ Suitable for single and double screen systems



### **Energy-efficiency benefits**

- ✓ Dehumidification with screens closed
- ✓ Less energy emission due to more screening hours
- ✓ Reduction of electricity usage through decentralized ventilation
- ✓ Energy-efficient crop activation in the morning through circulation
- ✓ Possibility of natural ventilation through roof vents
- ✓ Less need for dehumidification due to homogeneous climate

## Climate benefits

- ✓ Improved and homogeneous (micro)climate
- ✓ Top-down air treatment, resembling natural circumstances
- ✓ Heat from assimilation lighting mixes through horizontal circulation
- ✓ No fluctuations through draughts
- ✓ Natural and optimal cooling of crop from above
- ✓ Insight into plant conditions based upon Data Driven Growing Strategy
- ✓ Proactive response to weather changes to maintain optimal climate
- ✓ Fact-based decision-making, optimization of greenhouse climate
- ✓ Quick response to abnormalities
- ✓ Reduction of error margin based upon Data Driven Growing Strategy





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PROJECTS**

