



## 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.

## 荷兰稻桑 X-AIR 可持续智能温室解决方案

X-AIR 温室能够利用环境物理特性，根据数据驱动种植策略，以最少的耗能，创造最佳的室内生长条件。这使得作物在最短的时间内获得最高的产量和质量。目前的设施园艺需要新的可持续和节能的栽培技术和解决方案。X-AIR 温室注重植物平衡，通过可持续方式优化温室及其气候条件来促进植物和作物的生长。

**独特的稻桑 X-AIR 可持续温室解决方案**由稻桑（硬件）、豪根道生长管理（自动化系统）和 LetsGrow.com（数据集成）三剑合一。这三家企业之间的协作使种植者能够以可持续的方式优化产量。

## 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.

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ASSIMILATION LIGHTING SYSTEMS · COMBINED HEAT & POWER · MANAGEMENT · ADVICE · SERVICE

## 更低能耗，更低风险，更多的产量

这项新研发的 X-AIR™ 智能温室包含 X-AIR 通风系统。此项稻粦发明是节能气候控制系统的重要组成部分。该解决方案结合强制空气通风分流和循环使自然气流从温室上方输送至作物。同时通过将温室空气与外部空气或来自幕布上方的空气混合，在温室内营造最佳生长条件。这种实用紧凑的通风系统策略性地布置覆盖整个温室区域。

此外，控制室外空气输入后分流和再循环，使温室内气候以节能的方式降温 and 除湿。这种积极的气候控制技术确保温室可减少通风，更长时间的维持高二氧化碳 (CO<sub>2</sub>) 水平。这将直接转化为大幅度增产和降低能源成本。新一代 X-AIR™ 可持续智能温室将提供温度、二氧化碳、湿度、光合有效辐射和空气流动的最佳比率，以营造性能最佳的温室。

### 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

### X-AIR 温室如何促进植物生长:

- ✓ 在植物周围创造更大空气流动量
- ✓ 提高（微）气候的同质性
- ✓ 保持室内高水平的二氧化碳 CO<sub>2</sub> 含量
- ✓ 无论幕布是在打开还是关闭状态，都实现低能耗除湿
- ✓ 减少能源使用和排放
- ✓ 实时深入了解作物状态



### 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.

### X-AIR 通风机 (*正在申请专利*) 将通风系统推进一个新的水平

X-AIR 通风机专门设计用于将所需量的室外空气或幕布上方的空气混合到 X-AIR™ 温室中。与传统的温室通风窗类似，X-AIR 通风机在整个温室区域创建水平、比例相等的进气口。此通风系统兼容单屏或双屏系统的使用，不受幕布打开和关闭时的限制。

### 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

#### **X-AIR 通风机优势:**

- ✓ 强制与外部空气通风
- ✓ 强制与幕布以上空气通风
- ✓ 散风系统
- ✓ 可配用热交换器和/或除湿器进行模块式扩展
- ✓ 无论幕布是在打开还是关闭状态均可操作

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.



X-AIR 通风机系统使用经过验证的空气混合通风机（Van Der Ende 范德安德集团所获专利产品）作为 X-AIR 通风系统的基础。进气管道由荷兰稻桑 Dalsem 设计，并配有两个机动连接阀。此机制使外部空气或幕布之上的通风随意切换。稻桑 X-AIR 通风机完全融入温室屋顶系统，进气口连接在玻璃面板和格子梁之间。幕布经调整后，可确保与进气管道完美贴合。X-AIR 通风机可采用模块式扩展，配有热交换器和/或除湿器。将热交换器安装到 X-AIR 通风器中，可以冷却再循环空气或外来空气，并重新获得感热。根据当地气候，这些额外的选项为几乎所有气候条件下创造作物所需要的最佳温室气候。

#### **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.

### 数据驱动的智能温室

作为新研发的稻桑 X-AIR™ 可持续智能温室解决方案的一部分，【数据驱动种植策略】为作物定义最佳生长条件。由数据驱动种植理念呈现的两种套餐的第一种为‘专业套餐（1）’，它可以与‘高级套餐（2）’相结合进行日后的扩展。‘专业套餐’将是您数据积累的起点，使用由豪根道生长管理和 LetsGrow.com 应用系统支持集成的气候控制子系统。这种跨企业协作关系使荷兰稻桑 Dalsem 能够根据【植物赋能原则 GPE】保持植物生长条件的平衡，为种植者提供集成的数据驱动精准解决方案，以实现可持续温室作物生产。

【数据驱动种植策略】的优势是基于温室生成的数据、植物生理学和人工智能（AI）算法的组合。该策略包括三步法：（1）知识传承（2）实践中学习（3）实施和整合。如此一个不依靠个人的栽培平台系统可确保企业持续获得所有积累的知识和数据。【数据驱动种植策略】的核心是通过 LetsGrow.com 应用程序培训和数据分析，以便 24 小时洞察种植过程的限制因素。作为附加选项，‘高级套餐’中除了包括广泛的培训课程，同时还分析三年时间段内所有的结果和数据。此功能将实现数据驱动智能温室的自动化气候控制管理和灌溉管理。与机器人的数据连接将由 LetsGrow.com 实现。豪根道生长管理系统开发的一体式软件包解决方案，应用于管理和控制您的数据驱动智能温室。

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

这些子系统的具体配置取决于基地的气候条件和作物需求。这些配置在两种稻槩 Dalsem 数据驱动套餐中供选用：

- **专业套餐**

- ✓ 荷兰稻槩 X-AIR™ 温室设备模块，例如 X-AIR 通风器
- ✓ 自定义 X-AIR 仪表盘
- ✓ LetsGrow.com (GPE 植物赋能原则) 模块，例如基本植物生长条件和相对湿度
- ✓ 植物赋能原则参考书籍和相关电子学习工具
- ✓ LetsGrow.com 应用 app，包括病虫害登记
- ✓ 通过聊天功能进行企业内部沟通
- ✓ 传感器，例如热视图、光合有效辐射
- ✓ 智能摄像机
- ✓ 基于稻槩 X-AIR™ 仪表盘的培训
- ✓ 如何在实践中运用 GPE 植物赋能原则的培训
- ✓ 由 LetsGrow.com 应用平台每周提供在线培训和监控



### 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

### 高级套餐

- ✓ 专业套餐的所有功能
- ✓ 数据驱动种植策略：气候与灌溉管理
  - 设置时间段为三年
- ✓ 数据分析，例如光线利用率
- ✓ 达标线分析

- ✓ 与机器人的数据连接
- ✓ 由 LetsGrow.com 举办内容广泛的培训
  - 【数据驱动种植策略】和【植物赋能原则】的实际运用

### **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.

### **稻燊 X-AIR™ 可持续智能温室解决方案的优点**

在您使用新研发的稻燊 X-AIR™ 温室的同时稻燊将提供经改良的栽培方法。X-AIR™ 温室的其它优点还包括降低成本、提高能源效率和以最少的投入和浪费实现低风险的产量最大化。

### **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



### **优点概括:**

- ✓ 强制空气通风而不是自然通风（半封闭解决方案）
- ✓ 由于室内栽培气候得到优化，加上平均二氧化碳水平提高，使产量与品质相应提高
- ✓ 高投资回报率

- ✓ 通过知识积累和数据的结合，帮助种植者做到流程标准化和增强对种植过程的控制
- ✓ 在具有挑战性气候环境中延长种植期
- ✓ 提高空间利用率、避免浪费种植空间、对作物生产工作流程没有限制
- ✓ 幕布关闭通风同时不造成光散射
- ✓ 温室中的超压确保了稳定的气候控制，并降低了植物疾病发病率
- ✓ 使用昆虫网作为预防虫害措施
- ✓ 通过散风达到防止虫害传播
- ✓ 适用于所有类型的作物，如：蔬菜、水果、花卉或盆栽
- ✓ 适用于所有作物生产方法
- ✓ 适用于单层幕布和双层幕布系统

### 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

### 能效优势：

- ✓ 在幕布关闭状态也能进行除湿
- ✓ 因为更多的幕布使用时间，减低室内热能排放
- ✓ 通过分散通风减低用电
- ✓ 在清晨时段通过低能耗的通风操作激活并唤醒作物
- ✓ 保留屋顶通风口自然通风的可能性
- ✓ 由于室内气候均匀，减少对除湿需求

### 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

#### 气候效益:

- ✓ 改善和均匀（微）种植气候
- ✓ 自上而下的空气处理，效仿自然环境
- ✓ 人工辅助照明的热量与水平循环通风相混合
- ✓ 在抽风时不会有波动
- ✓ 对作物输送由上至下自然和合适的冷风
- ✓ 基于数据驱动种植策略洞察作物生长状态
- ✓ 主动应对气候变化，保持最佳室内生长环境
- ✓ 以实际情况为依据的决策，优化温室气候
- ✓ 对异常情况的快速反应
- ✓ 基于数据驱动种植策略降低误差幅度







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PROJECTS**

