

Translating the European Approach to Domestic Plant Production

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Summary

This paper details how European practices can be applied to plant production in North America. After multiple trips to the Netherlands and investigating how plants are produced overseas, only the most fitting automation and production ideas were brought to our greenhouse and implemented. From our state-of-the-art greenhouse to our

choice of environmental controls, we strive for top quality plants and ease-of-work and greater efficiency of our team. Our team is vital in our success, and if our automation and equipment can make their life easier and our plant quality better - we have succeeded.

INTRODUCTION

The Plant Company was founded in 2020 by Frank Paul (COO) and brothers Jason and Wes VanWingerden. The 2-ha (5-ac) state of the art greenhouse is for the production of indoor foliage and tropical plants. We currently produce multiple varieties of Philodendron, Alocasia, Ficus, Calathea, Syngonium, Aglaonema, pothos, Ctenanthe, Dieffenbachia, Tradescantia, and Monstera. Some 85% of our plant liners come from tissue culture. We purchase our plantlets from multiple labs throughout the world. We do this to ensure virus free plants for the

end consumer. The 15% of the propagules that we propagate as unrooted cuttings are tested with Agida[®] virus test strips <https://www.agdia.com/> upon arrival to our greenhouse - and watched closely in a quarantined area.

PRODUCTION AUTOMATION

We receive plant material the first half of the week and inspect each variety. All unrooted cuttings are treated before they are stuck. Tissue culture liners go straight to the sticking line (**Fig. 1**).

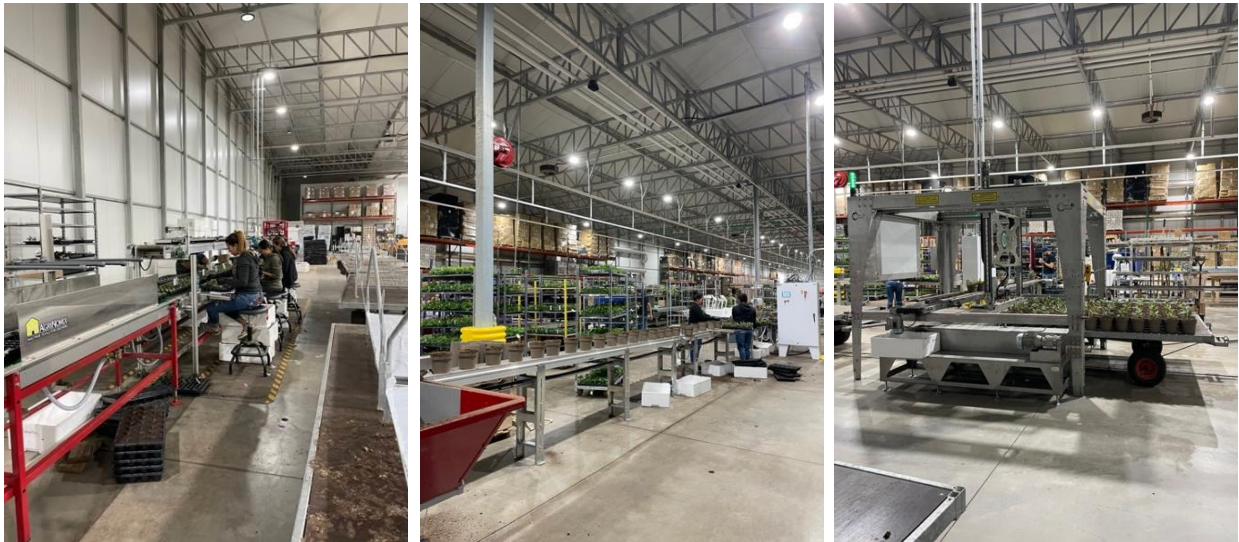


Figure 1. (Left) Ergonomic sticking tables, (center) potting line, and (right) a Gantry robot machine <https://www.sagerobot.com/gantry-robots/>

We use 3 sizes of trays: 72, 40 and 28. We run our trays through the tray filling machine, after filling, the media is irrigated once before sticking. Each seated team member will take one tray from the conveyor above and place it directly in front of them on their table for ease of sticking. After the tray is filled, it will be placed back on the conveyor to head to the next irrigation point before being placed on a grow rack. Once the trailer is full, the grow rack heads out to the liner area. Our trailers are pulled by battery powered tuggers (**Fig. 2**)

to eliminate any possible fumes inside the facility. All equipment inside the greenhouse is battery powered or electric (**Fig. 2**). Once the trailer reaches its assigned location our “flying forks” lift the grow rack from the trailer and place it on the floor (**Fig. 3**). This equipment requires only one person to operate. Once the racks are placed on the floor, we enclose them in poly to create a microclimate. This eliminates overhead irrigation and algae growth. After 10 days the poly will be vented. Once the liners are rooted, the poly comes off the grow racks.

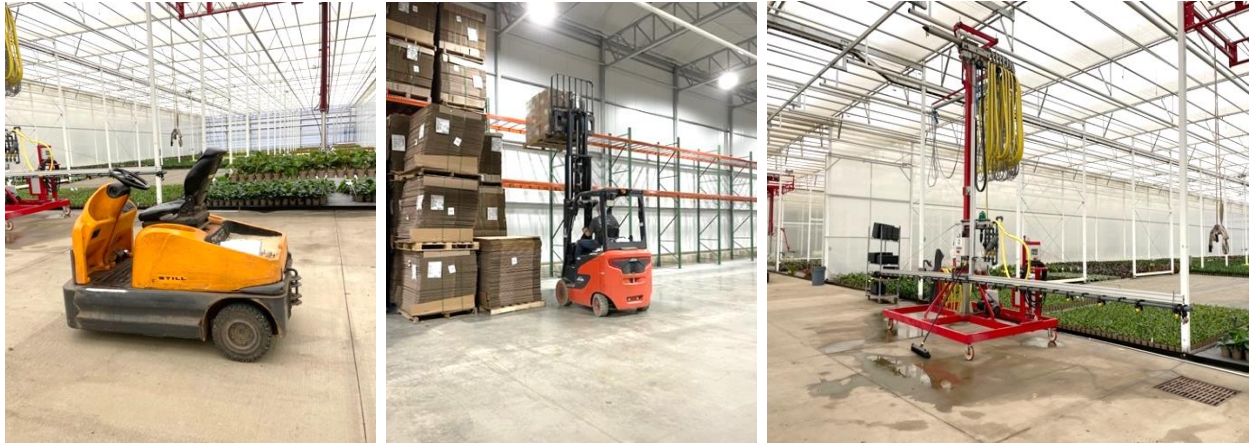


Figure 2. (Left) Battery powered tuggy, (center) forklift, and (right) and electric boom.



Figure 3. (Left) Flying forks (arrows) moving grow racks. (Right) Operator controlling grow racks.

This same equipment will be used to pick up grow racks of fully rooted plants for planting into 12-cm or 17-cm recycled plastic pots. We load our trailers with finished liners and head to the potting line (**Fig. 1**). Our machine has a pot dispenser that releases the pots onto the conveyor, fills the pot with media and dabbles a hole. Once planted the pot will go through a series of irrigation nozzles to lightly water the plant for its trip to the greenhouse. The potted plants are then gathered on the rail for the robot to place onto the trailer (Fig. 1). When a line on the trailer is full the trailer moves forward the required space for the next row of plants. When two trailers are full of

plants, we drive them to the greenhouse for placement in the proper environment using the flying forks (**Fig. 4**).

Greenhouse

The climate-controlled Venlo greenhouse <https://www.venloinc.com/> has six separate compartments with a glass roof. We keep each compartment at different light levels and humidity for optimal plant growth. We have photosynthetically active radiation (PAR) light sensors above and below the shade curtain. There is an energy curtain and a shade curtain in each compartment along with varying degrees of whitewash in the warmer months to achieve this. Our

“par perfect” energy curtain diffuses the light evenly over the crop - even if the shade is partially open. We use a high-pressure

fog machine to keep the humidity within the correct parameters in the greenhouse (Fig. 5).



Figure 5. (Left) Fog machine, (center) fresh water tank, and fertilizer recipe tanks for flood-floor, and (right) fertilizer injectors.

Our irrigation can be done with our mobile boom, overhead or with our flood floors. The electric powered boom is used when small areas need irrigation (Figs. 2 and 4). This piece of equipment can also be used to apply chemicals if needed for a precise even pattern.

When using the overhead irrigation, we can program the pH and EC needed for each individual bay. When we use the flood floors, we have two fertility recipes to choose from: a nitrogen rich formula and a potassium rich formula (Fig. 6).

The Plant Company
10th of January 2022

Fertilizing advice: **FOLIAGE PLANTS (start and N rich)** A1 / B1

25 per 2000 L stock tank

Solution A: Ammoniumnitrate (18%N)	litr	
Calciumnitrate (15%N, 20%Ca)	75 kg	1200
Magnesiumnitrate (11%N, 9.3%Mg)	13 kg	600
Calciumchlorid (85%)	kg	
Urea (46%N)	kg	1300
Iron chelate (DTPA 6%)	3 ltr	1100
Solution B: Potassiumnitrate (13.5% N, 38% K)	25 kg	1100
Monopotassiumphosphate (23%P, 28%K)	25 kg	1100
Potassiumsulphate (45%K, 18%S)	12.5 kg	550
Magnesiumsulphate (10%Mg, 13%S)	37.5 kg	1650
Manganesesulphate (32%)	200 gr	1800 20 oz
Boron(20.5%)	100 gr	900 10 oz
Zincsulphate (23%)	170 gr	1500
Coppersulphate (25%)	24 gr	1700
Sodiummolybdenum (40%)	24 gr	1700

The Plant Company
10th of January 2022

Fertilizing advice: **FOLIAGE PLANTS (K rich)** A2 / B2

25 per 2000 L stock tank

Solution A: Ammoniumnitrate (18%N)	litr	
Calciumnitrate (15%N, 20%Ca)	75 kg	1100
Magnesiumnitrate (11%N, 9.3%Mg)	kg	
Calciumchlorid (85%)	12.5 kg	550
Urea (46%N)	kg	
Iron chelate (DTPA 6%)	3 ltr	1100
Solution B: Potassiumnitrate (13.5% N, 38% K)	25 kg	1100
Monopotassiumphosphate (23%P, 28%K)	12.5 kg	550
Potassiumsulphate (45%K, 18%S)	12.5 kg	550
Magnesiumsulphate (10%Mg, 13%S)	50 kg	1200
Manganesesulphate (32%)	200 gr	1800 20 oz
Boron(20.5%)	100 gr	900 10 oz
Zincsulphate (23%)	170 gr	1500
Coppersulphate (25%)	24 gr	1700
Sodiummolybdenum (40%)	24 gr	1700

Figure 6. Recipes for (left) N-nitrogen-rich and (right) K-potassium-rich fertilization.

We mix the recipe ingredients individually so we can adjust if needed based on nutrient testing. Our flood floors are not made of concrete. They have a plastic layer at the bottom with crushed limestone in the middle and a fiber membrane on top. We program the volume of water by adjusting the

time the flood runs in each bay. We can use this floor to cool the greenhouse if needed by running a short program that will not irrigate our plants. All irrigation water is captured, whether overhead or flood, and returned to its appropriate silo for reuse (Fig. 5). To minimize our chance of disease we

inject Kleengrow™ <https://www.greenbook.net/pace-chemicals-ltd/kleengrow> directly into our water lines that are connected to the greenhouse (Fig. 5). Our heating is done with boilers that is a closed loop system with a tank outside that houses the water (Fig. 7). The heated water warms the warehouse, shipping area and greenhouse. In the greenhouse we have heat pipes in the



Figure 7. (Left) Hot water holding tank, and (right) boilers for heating the facility.

Our entire greenhouse environment is controlled by IIVO Hoogendoorn <https://readyssetgrow.nl/>. Just a few of the benefits of IIVO are ease of use, weather forecasting that will close vents in case of a storm, and my favorite - it can be controlled remotely with your phone. Our growers are able to access real time information from the greenhouse environment. We are also able to look at a year's worth of data, in an easy-to-read graph.

Since our greenhouse range is very open, we utilize beneficial insects to keep the pest populations in check. This program is modified with the seasons and pest pressure. We have used *Aphidius colemani*, lacewings, *Orius*, *Atheta*, *Swirski*, beneficial nematodes and *Persimilis*. If we need to apply chemicals, we use ones that work with our beneficial program. Some of those

floor, the gables, and the top of the greenhouse. Our heat is moved downward by vertical fans. Our plants benefit from higher CO₂ levels - so we are able to scrub the CO₂ from our natural gas boilers and send it back into the greenhouse. This is done by running our boilers during the day while storing the heat in our hot water storage tank.

chemicals we can use, and then apply beneficials four hours later! Our employees greatly appreciate the low use of any chemicals and the elimination of all harsh chemistries.

The mindset at The Plant Company is intense quality control - focused on plants and our staff. Our owners and directors are out in the facility observing the tasks to see if there is an easier way to get the job done. We believe and follow through with creating an environment where people have quality time outside of work. This European mindset has been communicated to our community and we are not at a loss for job applicants. With the back breaking tasks automated, we have people that enjoy coming to work every day and can go home at a reasonable time. As we say: "Together we grow stronger"!