MAXIMUM YIELD

Why Air Circulation Is Essential for Greenhouse Climate Control

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Takeaway: *Climate control is the key to ensuring that each and every plant grows under the same optimal conditions.*

Greenhouse growing is all about controlling climate conditions in order to optimize plant production. The temperature is constantly adjusted, the air is dehumidified and the lighting is precise. But what ensures these excellent conditions reach each and every plant evenly?

The answer is air circulation.

Managing Climate Conditions

Greenhouses are dynamic environments. They're affected by the weather outdoors, while maintaining different conditions inside. This requires constant attention and balancing. To complicate things further, the plants that fill the greenhouse constantly respirate and transpire, changing the environment surrounding them and often undermining our efforts to provide them with the best climate conditions.

The climate in a greenhouse is always changing. It fluctuates over time, as well as between different areas, heights, proximity from exterior walls, etc. It's extremely likely in a common greenhouse that not all plants are enjoying the environmental control efforts we put in. It's even more likely that they aren't all experiencing the same conditions at all. This is close to impossible to avoid, even when using smaller dehumidifiers and fans to combat specific local problems.

Microclimates Are Undermining Climate Control

Microclimates are essentially small pockets of air containing different conditions from the rest of the space. Monitoring in such small resolution isn't always practical or possible in a commercial greenhouse, so they may be difficult to locate. If there seem to be certain spots that are more susceptible to mold or other humidity diseases, you should suspect microclimates are to blame.

When talking about greenhouse microclimates (or any other closed or semi-closed growing facility, for that matter), the main culprit is the boundary layer, created by the plants themselves.

The boundary layer is a thin layer of air surrounding the plant. It's caused by the transpiration from the leaves, creating a cool and humid environment. When leaving this layer untouched, it leads the plant to experience a much different environment than intended. In thick foliage or densely placed plants, these layers overlap, creating an extremely humid environment. This may even lead to condensation occurring on the plants themselves, a major fault that may quickly lead to mold and disease outbreaks.

Boundary Layers Inhibit Plant Metabolism

It's not just molds and diseases, though. Boundary layers are a major nuisance to plant metabolism.

Plants transpire water through stomatal pores found on the leaves. When water evaporates from these pores, it creates a "pull," which causes water to be sucked in through the roots. This water contains the nutrients needed to grow and develop. But when the air surrounding a plant is too humid, water cannot evaporate, causing a decrease in nutrient uptake (this is often referred to as low VPD). It's therefore critical to maintain a good range of relative humidity around the plant. Or, in other words, to disperse the boundary layer.

Dispersing Boundary Layers Using Air Movement

Dispersing boundary layers may seem like a simple task. A slight breeze of air should do the trick. But most airflow schemes lead to similar problems as presented above. Our efforts may reach some of the plants and leave the rest unaffected. Some plants may experience a strong gust of wind, while others only receive a small whiff due to their proximity from the fans, or being blocked by other plants along the way. This may easily lead to a situation in which molds persist, plants underperform, and growth remains uneven, despite the efforts and capital invested.

The solution to this is found in proper air circulation. Creating cyclical movement, from the center outwards and back, provides the best and most even movement, reaching all plants regardless of their location in the greenhouse.

"Circulation" and "Flow" are not the Same

"Airflow" is a term commonly used in agriculture to describe any movement of air. Most greenhouses use fans to create movement in linear directions. Whether vertically or horizontally, this pushes air in a single straight direction. Combining different directions is common, but most often results in a chaotic air pattern that cannot be accurately predicted and is not evenly dispersed.

Air circulation is effectively achieved by releasing air at canopy level, from the center of the space, to all directions at once (360o), while sucking in air from all directions at ground level.

Matching air capacity with the size of the space is key. An area that's too large won't allow the air to effectively reach the perimeter. Vertical space is also important to consider. Minimizing it with the use of screens, for example, will allow the air to travel along the top more efficiently and reach all corners of the greenhouse.

It is also important to differentiate air circulation and airflow from ventilation. Ventilation brings in air from outdoors, which hasn't been treated for optimal greenhouse conditions, while circulation relies on moving interior air. This requires much less energy, as the air is already acclimated, reducing the need to heat, cool or dehumidify. Circulation may also be performed at any time, as opposed to ventilation which may be ineffective depending on the weather outside.

Climate Uniformity Is the Ultimate Goal

Understanding and applying air circulation is part of creating and maintaining optimal greenhouse climate conditions. In fact, it is the glue that binds all other efforts, such as heating and dehumidifying, to create a cohesive, homogeneous climate.

Climate uniformity has several benefits. It allows plant metabolism to operate at an optimal level, resulting in the highest quality product, as well the most even output, while reducing disease outbreaks almost completely. Often growers are forced to over-invest in efforts such as heating, due to a few problematic areas, while the rest of the space is sufficiently acclimated. This leads to inefficient energy use and unnecessary expenses. For example, over-working dehumidifiers due to bud rot showing up in specific spots, while most of the greenhouse is maintained at a safe and comfortable humidity level.

Air circulation negates microclimates and problematic areas, allowing growers to reduce energy inputs and lower expenses, while reducing crop

loss, increasing product quality and improving control over the entire production process.