

Going with the flow



Little Prince of Oregon uses rows of small fans in each greenhouse to maintain horizontal air flow. PHOTO BY VIC PANICHKUL

Proper ventilation and circulation are key to successful greenhouses

BY JON BELL

Take a stroll across the grounds of **Little Prince Nursery** in Aurora, Oregon, and you'd largely be traipsing around 20 acres filled with long, tubular greenhouses.

There are 90 of them to be exact, many of them from the Donald, Oregon-based manufacturer **GK Machine**. All are teeming with the succulents, shade plants and perennials that the nursery is well-known for.

Take that stroll in the summer, and you'd likely see those greenhouses acting a little more animated than one might expect.

If it were a warm day, for example, some of the greenhouses might automatically raise their sidewalls by a foot, hold for a few minutes and then raise another foot and pause. Others might lift the sidewalls a foot and simply stop or even lower back down. And if clouds or a shower rolled in, they'd all lower their walls until the weather passed, as if they were auton-

omous and reacting to the weather on their own. Which is exactly what they're doing.

"It's kind of a cool thing to watch," said Mark Leichy, director of operations for Little Prince. "In the summertime, they'll go through that multiple times, all of them going up and down throughout the day."

The almost-futuristic movements of Little Prince's greenhouses are the result of an automated controller that allows the nursery to input set points based on temperature, air circulation, ventilation and other factors to ensure the nursery's plants are enjoying optimal growth conditions. The technology isn't necessarily new — retractable sidewalls have been around for decades — but it is one of the most popular ways that nurseries are able to manage proper air flow and temperature in their greenhouses.

That's important. Air flow and temperature are among the most important considerations needed for plants to thrive.

"For greenhouse growers, investing in a well-designed ventilation system is essential," said Derrick Bratton, head of greenhouse sales for GK Machine.

"By addressing climate, size, and plant-specific variables, growers can maintain an optimal environment that supports healthy growth, prevents disease, and maximizes yield. Whether utilizing natural or mechanical systems, ensuring consistent and adequate airflow is critical to greenhouse management."

Blowing sideways

John Bartok is a retired agricultural engineer who spent decades with the University of Connecticut. One of his specialties is commercial greenhouse crops and the efficiency of greenhouses. He's conducted more than 200 energy audits for growers in the northeastern U.S. through a United States Department of Agriculture grant program.

Bartok has also worked with the U.S. Forest Service in Oregon on tree starts, and he also spent time in Russia helping set up greenhouses to assist in reforestation more than 5 million acres that had been burned in a wildfire.

When he began his work in the mid 1960s, there wasn't much thought given to the design of greenhouses and the importance of ventilation and air circulation. >>

Going with the flow

Without proper ventilation, circulation and temperature, plants in greenhouses cannot grow vigorously or efficiently. They can also be more susceptible to pests, fungus and disease.

One of the biggest innovations in the field came from one of Bartok's colleagues at UConn, Jay Koths, who in 1967 came up with what is now an industry standard: the concept of horizontal air flow (HAF).

According to UConn, HAF is based on the principle that "air moving in a coherent pattern in a building such as a greenhouse needs only enough energy to overcome turbulence and friction losses to keep it moving." Essentially, the air in a greenhouse just needs a little push to keep it circulating, which happens via a few properly sized and positioned fans that blow the air down one side of a greenhouse and then back down the other side.

"It's a system that looks like a race-track," Bartok said. "HAF is moving it down one side and then moving it back. Once you get the air moving, it keeps moving because the fans are helping it overcome friction."

The benefits of HAF are extensive. For starters, a HAF system helps maintain uniform temperatures. In greenhouses without HAF, temperatures can vary by as much as 10 F from one end to the other; with HAF, the differences are usually no more than 2 F.

HAF also prevents condensation from forming on plant leaves, which can lead to disease. Additionally, it replaces air that has been depleted of carbon dioxide with fresh and keeps leaves cool in the warmer months so they don't burn.

"Horizontal air flow circulates the air in the greenhouses, which is really important for plant health," Leichy said.

Another nice aspect of HAF is that it is a relatively inexpensive system to install. Standard fans are between \$150 and \$200 plus installation, and a 30-foot-by-100-foot greenhouse usually needs just four fans. (The USDA offers grants to cover these kinds of costs through its Environmental Quality Incentives Program.)

Companies that manufacture greenhouses, such as GK Machine, can help



Greenhouse manufacturers like GK Machine can help calculate the ventilation and circulation systems needed for any particular greenhouse and recommend solutions. In a test greenhouse at GK's property in Donald, Oregon, small fans (above) maintain air movement within the greenhouse and larger fans (below) ventilate the greenhouse. PHOTO BY VIC PANICHKUL



calculate the ventilation and circulation systems needed for any particular greenhouse.

“When selecting or designing a ventilation system, growers must evaluate key factors: climate conditions, greenhouse size and plant type,” Bratton said. “By prioritizing ventilation as a key operational element, growers not only improve plant health but also enhance productivity and efficiency in their greenhouses, solidifying their success in a competitive agricultural landscape.”

Kip Schuening, president of **Oregon Valley Greenhouses**, which manufactures heavy-duty greenhouse structures in Aurora, Oregon said his company helps customers size their circulation systems, including HAF fans and exhaust fans, based on the size of the greenhouse and the air mass inside.

“If you don’t calculate it right, you can get a vacuum effect inside,” he said, “and you can’t open your doors very easy.”

Tips for great greenhouses

GK Machine offered up this advice for growers looking to select or upgrade their greenhouses:

Understand your requirements: Determine your crop’s specific needs to ensure you choose an appropriate greenhouse and ventilation system.

Invest in scalable equipment: Systems that adapt to growth or environmental conditions are long-term solutions for optimizing performance without needing significant overhauls.

Leverage automation: Automated ventilation provides real-time adjustments and ensures precise control over temperature, humidity and airflow. These systems may require an upfront investment but can save on operating costs over time.

Regular maintenance: To maintain the system’s efficiency, keep vents clean, check fan operations and monitor airflow.

All natural

At **Blooming Nursery** in Cornelius, Oregon, operations manager Peter Gordon said the nursery tries to grow as much as it can naturally, outside. But it does have

greenhouses for its more tender perennials and herbs. They use HAF fans, but also have another system that uses a cool air fan, which is larger than most HAF fans. The cool air fan is connected to a long >>



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plastic tube that runs the length of the greenhouse. The tube is perforated with holes, so the air gets pushed out through them.

“It’s kind of a unique system, but it works really well,” Gordon said, noting that the tube can also be used for heating purposes.

Like Little Prince, Blooming Nursery also employs retractable sidewalls and roofs that open when conditions are favorable to encourage proper ventilation. Fans help keep the air circulating even when the sidewalls are up.

“Sidewalls are a good way to cool the air, then you have fans pushing it around,” Gordon said. “If you didn’t have fans, you wouldn’t have plants.”

It’s also important to keep an eye on temperature and weather conditions, especially when greenhouse sidewalls aren’t automated and set to raise or lower on their own.

“You can have days that are cloudy and cool, but then the sun pops out and the greenhouse heats up quickly,” Gordon said. “If someone’s not monitoring that, you can get heat fluctuations that can be detrimental.”

Bartok said fans used to be the standard approach to greenhouse ventilation, with fans pulling in and exhausting air, supplemented by side or roof vents. More common now is the natural approach to ventilation using retractable sidewalls and roofs that open and close.

“I don’t know of any fan-type systems going in anymore,” he said. “They’re too expensive, so most growers are doing all-natural ventilation.”

Top of mind

At Little Prince, Leichy said they try to do as much natural ventilation as possible, which allows for passive air flow, especially in the summer. It’s much more cost-effective

and efficient than using exhaust fans. In the winter, however, when the sidewalls can’t be raised, the HAF fans are running nonstop. He said exhaust fans are also used in the winter to keep the temperature inside their greenhouses cooler. Opening the sidewalls when it’s cold outside would send a rush of cold air across the plants inside, which could be calamitous.

Circulation and ventilation are always on Leichy’s mind, but even more so lately. Little Prince is about to add 10 new greenhouses specifically for hellebores, a crop that needs to be kept as cool as possible in the summer. Little Prince purchased the Winter Jewels brand of hellebores in 2023 and is ramping up its greenhouse operations to help meet growing demand.

“Hellebores are a big new crop for us,” Leichy said, “so we are positioning ourselves to meet the increased demand from people who want those plants.”

Getting the calculations right for the kinds of ventilation and circulation systems in those greenhouses will be key to Little Prince’s success with hellebores, as it has been with every other plant at the nursery.

“I think it’s one of the very top things that will make the success or failure of an operation,” Leichy said. “It’s just like with people: Living in an environment with clean, fresh air and water is critical to our well-being. The same is true with plants.” ☺

Jon Bell is an Oregon freelance journalist who writes about everything from Mt. Hood and craft beer to real estate and the great outdoors. His website is JBellInk.com.

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