



Olivia J. Liebing
liebing.4@osu.edu



W. Garrett Owen
owen.367@osu.edu

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Keep Your Cool: Maintenance Essentials for Fan-and-Pad Cooling

Higher light intensity and air temperatures can overheat greenhouses, creating an environment that is non-conductive for plant growth.

As spring turns to summer, greenhouse growers face the annual challenge of maintaining optimal temperatures for high-quality, marketable floriculture crops. The relationship between temperature and plant health is profound: temperature not only drives the rate of plant growth and development, but also influences the overall quality, compactness, and flowering of your crops. When air temperatures are too high, plants may



Figure 1. Chlorotic (yellow) and bleached (white) foliage and inflorescence necrosis (death) are symptoms of heat stress in zonal geraniums. Photo by: W. Garrett Owen, OSU.

exhibit heat stress symptoms such as stem elongation, flower delay or abortion, pale flower color, and/or chlorotic (yellowing) or bleached (whitening) leaves (Fig 1). These symptoms can diminish plant marketability and ultimately affect your bottom line.

Fan-and-pad cooling systems are a cornerstone of greenhouse climate management, especially during periods of high heat. These systems leverage the natural process of evaporative cooling to lower air temperatures and create a favorable environment for your crops. Fan-and-pad cooling cools the greenhouse air through the process of evaporation. Hot, dry air is drawn through a water saturated pad by exhaust fans located

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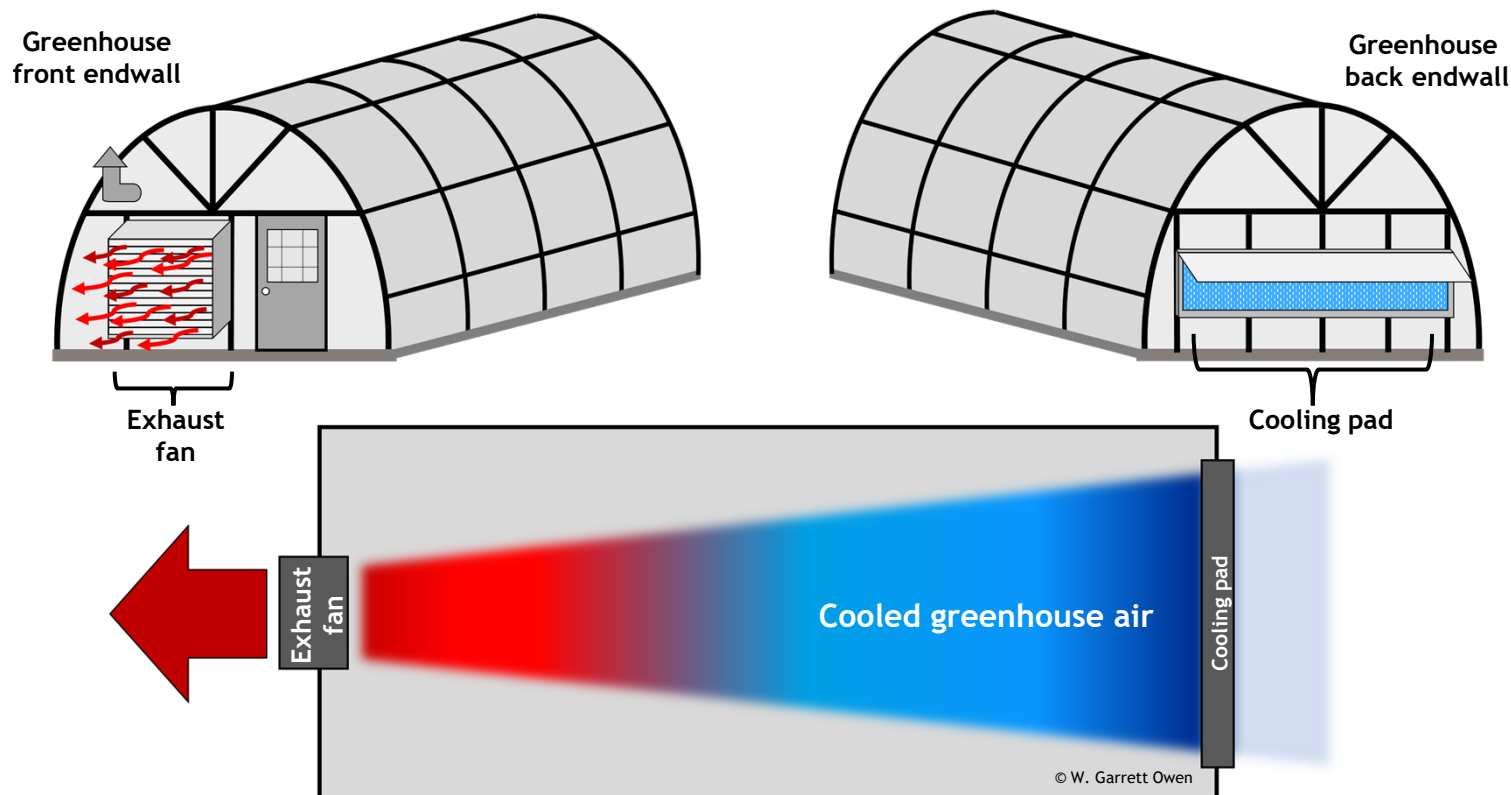


Figure 2. Schematic representation of a free-standing greenhouse with a fan-and-pad cooling system. In this system, hot, dry air is drawn through a water-saturated pad, where it is cooled by evaporation before being pulled across the greenhouse by exhaust fans. Figure by: W. Garrett Owen, OSU.

on the opposite end of the greenhouse and water is then evaporated as the hot, dry air contacts the wet pad. This process of evaporation is what cools the air as it exits the pad. The cooled air is then further pulled across the greenhouse by the exhaust fan (Fig. 2). This process not only helps maintain target temperatures but also supports consistent plant quality and productivity throughout the warmest months.

However, the effectiveness of a fan-and-pad system depends on regular inspection and maintenance. Even small issues—such as a partially dry pad, a slipping fan belt, or a clogged intake screen—can significantly reduce cooling capacity and increase energy costs. By proactively maintaining your system, you can avoid these pitfalls, maximize cooling efficiency, and ensure you are maintaining an optimal greenhouse environment all season long.

Management Concerns and Solutions

1. Pad Saturation

Proper pad saturation is fundamental for consistent evaporative cooling. The cooling pad must be uniformly wet to maximize the cooling effect as air passes through. Begin by ensuring the reservoir sump pump is delivering an adequate and consistent flow of water to the top gutter of the pad system. This can often be automated so that the pump operates when the exhaust fans reach a certain power usage or temperature setpoint, ensuring synchronization between water delivery and air movement. Inspect the gutter and pad regularly for dry spots (Fig. 3), which may indicate a blocked gutter emitter or insufficient water volume reaching the end of the gutter. Dry areas on the pad reduce the system's cooling capacity and can create uneven temperature zones.

within the greenhouse. Address any blockages or pump issues promptly to maintain even pad saturation and optimal cooling performance.

2. Build Up on Pad

The constant moisture present in cooling pads creates an ideal environment for algae growth, which can be visually identified as green or brown slimy patches. Algae not only degrades the cellulose pad material, shortening its lifespan, but can also restrict airflow and reduce cooling efficiency (Fig. 4). To control algae, apply greenhouse-safe algaecides or disinfectants directly to the pad or to the reservoir, following manufacturer recommendations and ensuring that products used are not phytotoxic to nearby crops (Fig. 5). In addition to algae, mineral deposits such as salt or calcium can accumulate on the pad surface as water evaporates and leaves particulates behind (Fig. 6). This is particularly common when using water with high salinity or elevated pH. These deposits are not only potentially corrosive to system components but can also block airflow and further reduce cooling capacity. To minimize mineral build-up, consider adjusting water pH with acidification or using purified water sources. Periodically rinsing the pads and reducing the frequency of pad dry-down cycles can also help prevent excessive deposits.

3. Leaks

Leaks in the pad-and-fan cooling system are often the result of poorly connected or aging fittings in the pad gutters or cycling pipes (Fig. 7). Even small leaks can lead to significant water waste over time and may disrupt the dosing of algaecides, disinfectants, or other water treatments, thereby reducing

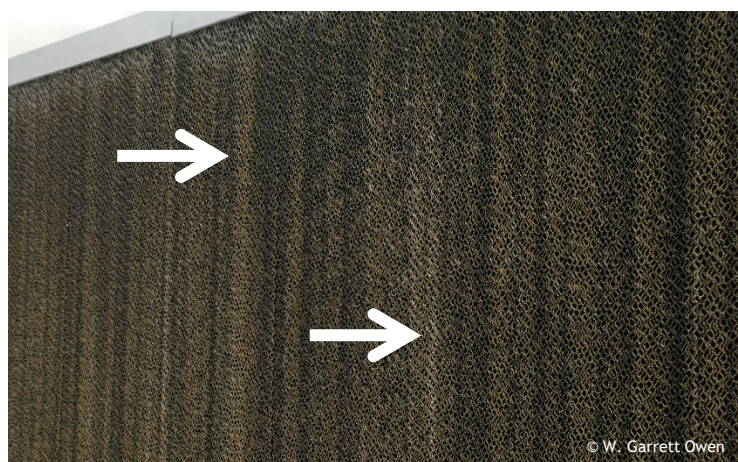


Figure 3. Example of dry spots of an aged cooling pad which caused by blocked gutter emitters. Photo by: W. Garrett Owen, OSU.



Figure 4. Algae build up on cooling pads can greatly reduce pad efficiency and life span. Photo by: Olivia J. Liebing, OSU.



Figure 5. Algaecides and disinfectants can be injected into a hose and applied to the pad during routine greenhouse cleaning. Likewise, they can be dosed into the pad reservoir as a part of preventative maintenance. Photo by: Olivia J. Liebing, OSU.

their effectiveness. Additionally, leaks can create hazardous puddles on the greenhouse floor, especially since pads are typically located at one end of the structure where foot traffic is high. These wet areas pose a slip risk for employees and can damage flooring or nearby equipment (Fig 8). Regularly inspect all connections, tighten loose fittings, and replace worn or damaged gaskets to maintain a watertight system and promote both safety and efficiency in your greenhouse.

4. Fan Efficiency

Exhaust fans are often the first line of defense against rising greenhouse temperatures, operating before the cooling pads are fully wetted. For optimal performance, fans should be positioned opposite the windward intake vents and cooling pads to maximize airflow across the greenhouse. This placement ensures that cooled air is drawn evenly across the crop canopy, promoting uniform temperature distribution throughout the greenhouse.

5. Fan Belt Inspection and Maintenance

A key aspect of fan maintenance involves regular inspection of the drive belts. Over time, fan belts can become loose, cracked, or worn (Fig. 9), leading to slippage that reduces airflow and forces the motor to work harder, increasing energy costs and the risk of premature motor failure. Signs of a slipping or failing belt include a high-pitched whining sound, visible slack, or a burning odor. Additionally, broken fan belts will not allow the exhaust fan function and fail to cool the greenhouse. To maintain reliable fan performance, check belts frequently and tighten or replace them at the first sign of wear or damage (Fig. 10).



Figure 6. Mineral deposits such as salt or calcium can accumulate on the pad surface as water evaporates and leaves particulates behind thereby reducing cooling efficiency. Photo by: W. Garrett Owen, OSU.



Figure 7. Water is leaking out of the return pipe from this pad-and-fan system, not only reducing efficiency but creating a puddle below in a busy walkway. Photo by: Olivia J. Liebing, OSU.



Figure 8. Leaks from cooling pads and gutters can create hazardous puddles on the greenhouse floor which pose a slip risk for employees, can damage flooring or nearby equipment, and promote algae growth. Photos by: W. Garrett Owen, OSU.

6. Wire Screen Cleaning for Optimal Air Intake

Attention should be given to the wire screens installed over exhaust fans, cooling pads, and other ventilators. These screens are essential for keeping debris and pests out of the ventilation system, but they can become clogged with dust (Fig. 11), plant material, or algae, restricting airflow and reducing system efficiency. To prevent blockages and ensure unobstructed air movement, inspect and clean wire screens regularly using a soft brush or compressed air. Consistent maintenance of both fan belts and wire screens will help keep your fan-and-pad cooling system operating at peak efficiency throughout the growing season.

7. Air Leaks

Leaving greenhouse door ajar (Fig. 12) or air leaks can occur when there are unintended openings in the greenhouse exterior, often near doors, vents, or poorly sealed joints. These leaks can significantly reduce the overall airflow across the greenhouse, diminishing the cooling capacity of the pad-and-fan system by allowing cooled air to escape or hot air to enter without passing through the pads. This not only reduces the effectiveness of temperature control during the summer but also increases heating costs in the winter by allowing warm air to leak out. Regularly inspect all potential leak points, including around doors, vents, and structural seams. Ensure doors and vents close tightly and repair or replace any worn seals or weatherstripping. By eliminating air leaks, you can enhance the efficiency of your cooling system in the summer and improve heat retention in the winter, providing year-round energy savings and better environmental control for your crops.



Figure 9. Over time, exhaust fan belts can become loose, cracked, or worn. Photo by: Olivia J. Liebing, OSU.



Figure 10. Installation of a new exhaust fan belt. Photo by: W. Garrett Owen, OSU.

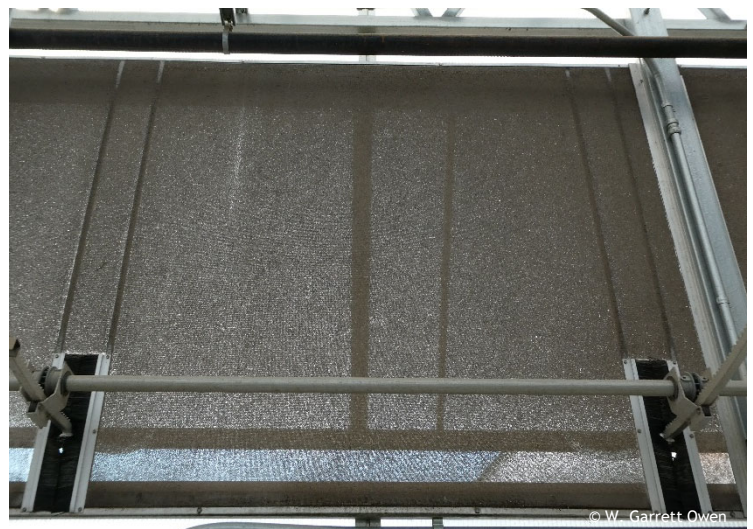


Figure 11. Example of a wire screen installed over a ventilator has become clogged with dust and debris, restricting airflow and reducing system cooling efficiency. Photo by: W. Garrett Owen, OSU.



Figure 12. Leaving greenhouse door ajar significantly reduces the overall airflow across the greenhouse, diminishing the cooling capacity of the pad-and-fan system by allowing cooled air to escape or hot air to enter without passing through the pads. This action reduces the effectiveness of temperature control during the summer. Photo by: W. Garrett Owen, OSU.

Conclusions

Prioritizing the maintenance of your cooling pads, exhaust fans, and overall greenhouse structure is essential for preventing cooling inefficiencies and ensuring the long-term reliability of your equipment. Key practices include maintaining proper pad saturation, minimizing algae and mineral build-up on pads, ensuring fans are correctly positioned and belts are well-tensioned, and sealing air leaks throughout the greenhouse. By consistently attending to these maintenance tasks, you can maximize the cooling efficiency of your fan-and-pad system, safeguard your investment in equipment, and provide optimal growing conditions for high-quality plants throughout the warmer months (Figure 7). Regular upkeep not only supports plant health and marketability but also contributes to energy savings and operational peace of mind.

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CONTRIBUTORS

Dr. Nora Catlin
Floriculture Specialist
Cornell Cooperative Extension
Suffolk County
nora.catlin@cornell.edu

Dr. Chris Currey
Assistant Professor of Floriculture
Iowa State University
ccurrey@iastate.edu

Dr. Ryan Dickson
Greenhouse Horticulture and
Controlled-Environment Agriculture
University of Arkansas
ryand@uark.edu

Dan Gilrein
Entomology Specialist
Cornell Cooperative Extension
Suffolk County
dog1@cornell.edu

Dr. Chieri Kubota
Controlled Environments Agriculture
The Ohio State University
kubota.10@osu.edu

Heidi Lindberg
Floriculture Extension Educator
Michigan State University
wolleage@anr.msu.edu

Dr. Roberto Lopez
Floriculture Extension & Research
Michigan State University
rglopez@msu.edu

Dr. Neil Mattson
Greenhouse Research & Extension
Cornell University
neil.mattson@cornell.edu

Dr. W. Garrett Owen
Sustainable Greenhouse & Nursery
Systems Extension & Research
The Ohio State University
owen.367@osu.edu

Dr. Rosa E. Raudales
Greenhouse Extension Specialist
University of Connecticut
rosa.raudales@uconn.edu

Dr. Alicia Rihn
Agricultural & Resource Economics
University of Tennessee-Knoxville
arihn@utk.edu

Dr. Debalina Saha
Horticulture Weed Science
Michigan State University
sahadeb2@msu.edu

Dr. Beth Scheckelhoff
Extension Educator - Greenhouse Systems
The Ohio State University
scheckelhoff.11@osu.edu

Dr. Ariana Torres-Bravo
Horticulture / Ag. Economics
Purdue University
torres2@purdue.edu

Dr. Brian Whipker
Floriculture Extension & Research
NC State University
bwhipker@ncsu.edu

Dr. Jean Williams-Woodward
Extension Plant Pathologist
University of Wyoming
jwilwood@uwyo.edu

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