

## Grower 101:

# Exploring Underbench Heating Options



Root zone heat can benefit crops and help lower energy costs, but it is important to first select the right system components for your operation's needs.

By John Bartok, Jr.

Uniform temperature in the root zone is difficult to achieve with a furnace heating system that circulates heat over the top of the crop or a boiler that pumps water through fin radiation along the sidewalls. Locating the heat on top or under the benches warms the containers first before it rises to heat the air, and for most crops, soil temperature is more critical to good growth than air temperature.

An added benefit to root zone heating is the potential savings in fuel costs throughout the heating season. Air temperature in the greenhouse can be 5-10° F lower than soil temperature and still achieve excellent growth. This lower air temperature means the heat loss between inside and outside the greenhouse is less, which results in a 10 percent or more reduction in fuel usage.

Research by Bill Roberts and others at Rutgers University has shown that about 20 Btus per sq.ft. of bench area is adequate to provide root zone heat without drying plants too much or killing tender roots. In Northern climates, this will provide about 25 percent of the total heat a greenhouse needs on the coldest night. During spring and fall, it will probably provide all the necessary heat.

The components of a root zone heating system include a hot water heat source, distribution piping, radiation and a control system. This article will examine these components to see what the options are.

### Select A Hot Water Source

If you presently have a boiler system heating

the greenhouse, it can probably be modified to give the 100-130° F water needed for root zone heat. The existing capacity should be adequate as the heat is just being redirected from fins or pipes to the root zone area.

If you have a condensing boiler, one in which the boiler can operate safely with a return water temperature less than 140° F, then the high-limit switch is set to the highest temperature water that you want in the root zone piping. If the boiler will be used for both high temperature (180° F) and root zone heat, then a bypass loop and mixing valve will be necessary to get low-temperature water.

Most greenhouse boilers are the non-condensing type and require a bypass loop and mixing valve to keep the water temperature in the boiler above 140° F. A 3-way valve is commonly used to allow water from the boiler to be mixed with return water from the root zone and directed back to the boiler or mixed with the return water and fed into the root zone system.

With the current interest in alternative energy systems, wood and coal boilers are making a comeback. Because fire control is more difficult with these systems and heat continues after the damper is closed, a buffer tank is usually installed. This tank, with a capacity of several hundred gallons, stores the excess hot water from the boiler. After mixing it with the return water from the root zone, the water is then distributed back to the root zone at the desired temperature.

For providing root zone heat to a single hoop house or small bench area, a domestic hot water heater will do an excellent job. These heaters fired



*Top:* A small boiler is a good source of hot water for the root zone heating system. Different temperature zones are supplied water from circulating pumps and controlled by remote bulb thermostats. *Bottom:* For small bench areas up to 2,000 sq.ft., a domestic hot water heater works well. The thermostat on this oil-fired heater is set to the desired 100-120° F water temperature. (Photos: John Bartok, Jr.)

# SEE THE DIFFERENCE.



## There is a difference when it comes to retail greenhouses!

X.S. Smith understands the unique needs of retail centers and can custom design a facility to both sell and grow plant material, while meeting the requirements of any local building codes. Without compromising street appeal, X.S. Smith engineers can design a retail center for any customer's selling environment.

Tell us your retail goals and find out how an X.S. Smith greenhouse will work for you.

**X.S. Smith.. The Retail Greenhouse Specialists.**



DRAWER X • RED BANK, NJ 07701 • TOLL FREE 1-800-631-2226  
In NJ (732) 222-4600 • FAX (732) 222-7288

[www.xssmith.com](http://www.xssmith.com) • [info@xssmith.com](mailto:info@xssmith.com)

# DEGLAS TAKES A HAIL OF A STORM

degussa.  
creating essentials



## High impact acrylic withstands hail where polycarbonate failed.

In 2005, Jordan's Greenhouses, located in Colorado, experienced a vicious storm that pounded their greenhouses with golf ball-sized hail stones. Greenhouses that were glazed with polycarbonate experienced 75% damage, unlike those covered with DEGLAS® High Impact Acrylic.

"In our unpredictable weather climate, we can't afford to be concerned about whether or not our greenhouses will stand up to hail storms. We need to be confident that they are durable and that our crops will not be ruined due to damage caused by such weather events."

Warren Jordan replaced his damaged polycarbonate with DEGLAS High Impact Acrylic. Now 95% of his operation is glazed with acrylic. He chose DEGLAS for its unsurpassed longevity, clarity, light transmission, energy savings, and strength.

Please visit our website and read more about Jordan's Greenhouses' hail storm experience and see how DEGLAS can protect you too.

**DEGLAS®**  
HIGH IMPACT ACRYLIC GLAZING

Commercial Greenhouses • Research Facilities  
Institutional Greenhouses • Garden Centers

1-888-2DEGLAS  
[www.deglasamericas.com](http://www.deglasamericas.com)

D LIGHT FULL ENVIRONMENTS

degussa.  
CYRO



Build with the best. Contact one of these manufacturers for more information on DEGLAS or call us to receive our brochure.

Write in 211



Pots are warmed from the bottom on this small-diameter EPDM rubber tubing system.

by gas, oil or electricity are available in capacities from 30,000 to 40,000 Btus per hr. and will heat up to 2,000 sq.ft. of bench area. Larger commercial water heaters and instantaneous water heaters have also been used with good success.

### Select Appropriate Piping

The distribution pipe that carries hot water from the boiler to the root zone system needs to be selected carefully. For the bypass loop and piping near the boiler, metal pipe — either copper or iron — should be used, as the water temperature is hot. If the water temperature that will be distributed in the root zone is less than 130° F, PVC is a good choice because it softens and sags at temperatures above 140° F.

The system should be designed so the pipe loops are as short as possible to reduce friction and heat loss. Locating the boiler near the center of the bench area to be heated will accomplish this. Using a 3-pipe, reverse return system will provide the same temperature water to all the loops. The system can be zoned so individual benches or areas in the greenhouse can be heated to different temperatures. Each zone requires a separate circulating pump and piping. Insulate the high-tem-

perature and large-diameter pipes that carry large volumes of water to save energy.

### Select Your System

There are several systems that are used to provide heat in the bench area. Containers in contact with the heat source will get conductive and convective heat. Where there is no contact, the heat is transmitted mostly by radiation.

Bench mats or EPDM tubing spaced 2-3 inches apart works well for propagation and containers. The water flows through the pipes from the warm-water manifold or pipe and loops back to the cold-water manifold or pipe. The tubing and mats should withstand UV light, fertilizers and high temperatures.

Some growers have attached PEX (cross-linked polyethylene) tubing to the underside of wire mesh benches. Besides being resistant to abrasion and chemicals, PEX stops oxygen diffusion, which can cause corrosion in boilers, tanks and plumbing.

It is also possible to suspend bare iron pipe or low-output fin pipe about 18 inches beneath the bench. Usually the pipe is hung by a chain or hooks to the bench support frames. Filled with 120° F water temperature, ▶



Rubber tubing and PVC pipe are used to supply this flat-top root zone heat mat. PVC pipe can handle up to 130° F water without sagging.

## Subirrigation Delivery Of Bonzi

Bonzi is very effective when delivered to the media as a substrate drench. The drench treatments provide better and longer lasting control of vigorous crops and have little effect on flower size and timing compared to sprays.

Bonzi is approved for application via irrigation systems (chemigation), including drip tubes, irrigation booms, hand-held wand with an injector and subirrigation (ebb and flow benches, flood floors and water collecting saucers). Users should consult the Bonzi label for specific requirements of systems used for chemigation.

Applying Bonzi via subirrigation is a relatively new procedure and different from other, traditional drench techniques. It is common, at first, for users to be a little apprehensive about this method. While users do need to be very aware of the details involved with using Bonzi in subirrigation, this method offers significant advantages, such as treating a large number of plants with minimal labor and providing an easy method for achieving uniform treatment of all plants. Also, distribution within the media is more uniform, which is important where there are multiple plants per container. Subirrigation allows “drenching” of smaller pots or packs where a traditional drench is difficult or impossible.

Bonzi is also more active when applied in subirrigation than it is in a traditional drench to the surface of the media because there may be more roots near the bottom of the container where Bonzi is concentrated when applied by subirrigation. Therefore, the optimum Bonzi rates for a one-time application in subirrigation should be evaluated starting at 50-75 percent of the optimum rates used in a traditional drench.

Another emerging strategy in subirrigation is to use continuous or multiple applications. For this, the optimum Bonzi rates are 10-30 percent of the traditional drench rates. This allows more flexibility, as the Bonzi can be metered out more uniformly over the crop during periods of rapid growth, thereby controlling and delivering Bonzi at several stages in the development and growth of the plants.

Maximize Profitability.  
Right-size Your Plants.

**Bonzi®**  
Ornamental Growth Regulator

©2006 Syngenta. Syngenta Professional Products, Greensboro, NC 27419.  
Bonzi® is a trademark of a Syngenta Group Company.

Write in 703

## equipment



**Left:** Low-output fin radiation is easy to install and out of the way of plant handling. Rubber tubing connects the separate runs of aluminum pipe. **Right:** A plastic weed mat material attached to the bench sides contains the heat underneath the bench and allows the air temperature to remain cooler.

an 1½-inch bare steel pipe will give off about 50 Btus per linear foot. A three-fourth-inch-diameter aluminum pipe with two 1-inch fins will give off the same number of Btus and hold only one-third the volume of water. This reduces the water needed in the system and the overshoot in temperature once the system shuts off. Under a 6-ft.-wide bench, a loop of either the bare pipe or fin will provide the needed 20 Btus per sq.ft.

### Circulating Pump And Control

A heating system circulating pump is typically used to move heated water through the radiation. In a system with multiple zones, either one pump per zone or a single larger pump with zone valves is used. The pump needs to be sized depending on the number of loops and the friction loss in the piping. Being a closed system, there is no head loss due to pipe elevation.

The sensor that controls the flow of hot water

to the root zone radiation should be placed in a representative pot or flat in the middle of one of the benches. The simplest control is a thermostat with a remote sensor bulb. The root zone system can also be connected as the primary heat zone to many controllers and computers.

### Operating Hints

If you install the radiation under the bench, attaching an 18-inch skirt to the sides of the bench will trap the heat and keep it from escaping and heating the air in the greenhouse. Weed barrier mats or plastic sheets work well for this.

To prevent a chimney effect from losing the under-bench heat, keep the bench full of plants, lay a weed barrier mat on the bench top before placing the pots down or cover any sections where plants have been removed with plastic sheeting or other material.

Root zone heat on benches can provide more

uniform temperature control than a heating system used to maintain air temperature in a greenhouse. This results in better germination of seed, faster rooting of cuttings and better plant growth and disease control in potted plants. The system will pay back quickly in fuel savings due to the lower air temperature that can be maintained. **[GPN]**

**John Bartok, Jr. is an agricultural engineer and extension professor emeritus in the Natural Resource Management and Engineering Department at the University of Connecticut, Storrs, Conn. He may be reached at [jbartok@rcn.com](mailto:jbartok@rcn.com).**

### LearnMore

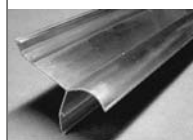
For more information related to this article, go to [www.gpnmag.com/lm.cfm/gp100606](http://www.gpnmag.com/lm.cfm/gp100606)

## Convert existing Roll-Up Curtains to a Roll-Up/Lock-Down Curtain System

### Econoline Roll-Bar Cap

1. Clasps against any standard 1.315" OD pipe.
2. Clasps continuously along full length of the bar.
3. Clasps single or multi layers of curtain materials
4. Tension can be applied in either rolling direction to allow locking down under Posi-Clasp optional Roll-Lock System
5. Easily converts and improves your existing system.

**So...THROW AWAY those troublesome plastic clips for good!**



### Posi-Clasp Roll-Lock

creates a fully sealed covering at the bottom of the roll-up sides, eliminating air infiltration and heat loss. Locks down to lessen wind flap and extend poly life.

Item	Description	Under 24 Pieces	24+ Pieces
RL8	8' Posi-Clasp Roll-Lock	\$32.00	\$30.08
RL12	12' Posi-Clasp Roll-Lock	\$48.00	\$45.12



**ADVANCING ALTERNATIVES inc.**  
717 Schuylkill Mountain Road  
Schuylkill Haven, PA 17972  
Phone 570-739-1034 Fax 570-739-1258

TOLL FREE: 1-877-546-2257



## This is Your Association

Member benefits include floriculture education, networking resources, professional development, and public awareness.

[www.ofa.org](http://www.ofa.org)



Write in 721

Write in 754