

11-3-2008

101 Ways to Try to Grow Arabidopsis: Can a Greenhouse Bench or Shelf Be Air-Conditioned?

Robert Eddy

Purdue University, robeddy@purdue.edu

Daniel T. Hahn

Purdue University, dhahn@purdue.edu

Follow this and additional works at: <http://docs.lib.purdue.edu/pmag>

Suggested Citation

Eddy, Robert and Hahn, Daniel T., "101 Ways to Try to Grow Arabidopsis: Can a Greenhouse Bench or Shelf Be Air-Conditioned?" (2008). *Purdue Methods for Arabidopsis Growth*. Paper 17.
<http://docs.lib.purdue.edu/pmag/17>

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

Purdue Methods:



Can a greenhouse bench or shelf be air-conditioned?

Short answer:

Yes

Results:

We built an air-conditioned light shelf for \$540 and an air-conditioned bench for \$470. (For details, see Materials and Methods for *Modifying a greenhouse table and greenhouse light-shelf with portable air-conditioners for improved cooling*). This cost estimate does not include components we had on hand such as greenhouse bench, extension cords, timers and thermometers. Both the shelf and bench were located in the same greenhouse, close to the exhaust fans to purge the additional heat created by the a/c units before they added heat load to the greenhouse room. The other advantage of building these in the greenhouse was the presence of floor drains for watering, and the ability to safely apply pesticides.

Both the shelf and bench grew healthy *Arabidopsis* crops with no signs of stress through July when greenhouse temperatures reached a maximum of 85F (29.4C) or higher on nine days of the experiment. Temperature on the air-conditioned bench was usually less than 70F (21.1C), and less than 75F (23.9C) on the shelf.

Discussion:

Though the air-conditioned bench was cooler, we believe the shelf could have been just as effective with air distribution fans to better mix the air. The lower shelves closest to the a/c units were several degrees cooler. Toward the end of the experiment, on July 19, we added a small fan for vertical distribution. However, this required space on each shelf for air to flow so the potential loss of three trays' worth of space. The advantages of the a/c bench were that it received more light, the light was more uniform, and was easier to construct. It's larger capacity a/c units provided much more flexibility, as well. Those units were turned down from their maximum setting because the day temperature was 60F (15.6C), cooler than was required. The advantages of the a/c shelf were that it took up much less floor space and required smaller, less expensive a/c units.

Prior testing in summer 2005 (data not shown) had taught us that a critical part of the construction was the insulation of the bench top with foam board insulation. The shelf was similarly insulated on the north side with reflective "bubble wrap."

Having two a/c units in each growth area constructed, with each a/c unit on a separate electrical

circuit was a critical failsafe; if the a/c unit fails in a system like this, the resulting temperature under the plastic would soar much higher than the greenhouse temperatures. Also critical was the placement of the a/c units near greenhouse exhaust fans so that their heat load would not be added to the room. Note that the a/c units and fluorescent lights had a ground fault interrupter (GFI) for safety in a wet environment. Consult with your electrician on appropriate electrical safety in your facility prior to using this equipment.

We believe this is an economical research tool that when properly safe-guarded as we described, provides a safe environment for plants that would otherwise perish in hot greenhouse conditions, at a fraction of the cost of a growth chamber. We have used it effectively three summer seasons for weak mutant plants.



Figure 1. The completed air-conditioned plant shelf, with the two layers of clear plastic peeled back.



Figure 2. Step-by-step construction of air-conditioned shelf: assembled plastic shelf bought a local home store; placement of a/c units; placement of lights; installation of reflective insulation; application of side plastic; sealing of plastic around a/c units; placement of timers; first layer of door plastic with slit down middle; and second flap of door plastic, held down with spring clamps.



Figure 3. The completed air-conditioned plant bench, with the two layers of clear plastic peeled back.



Figure 4. Step-by-step construction of air-conditioned greenhouse bench: unmodified bench; placement of 2-inch foam board; placement of metal framing to create compartment; placement of a/c units near greenhouse fan; sealing of plastic around a/c units; two layers of clear plastic draped over frame, weighted down with spring clamps.

Maximum Temperatures of Outdoors, Greenhouse, A/C Bench and A/C Shelf for 30 Days

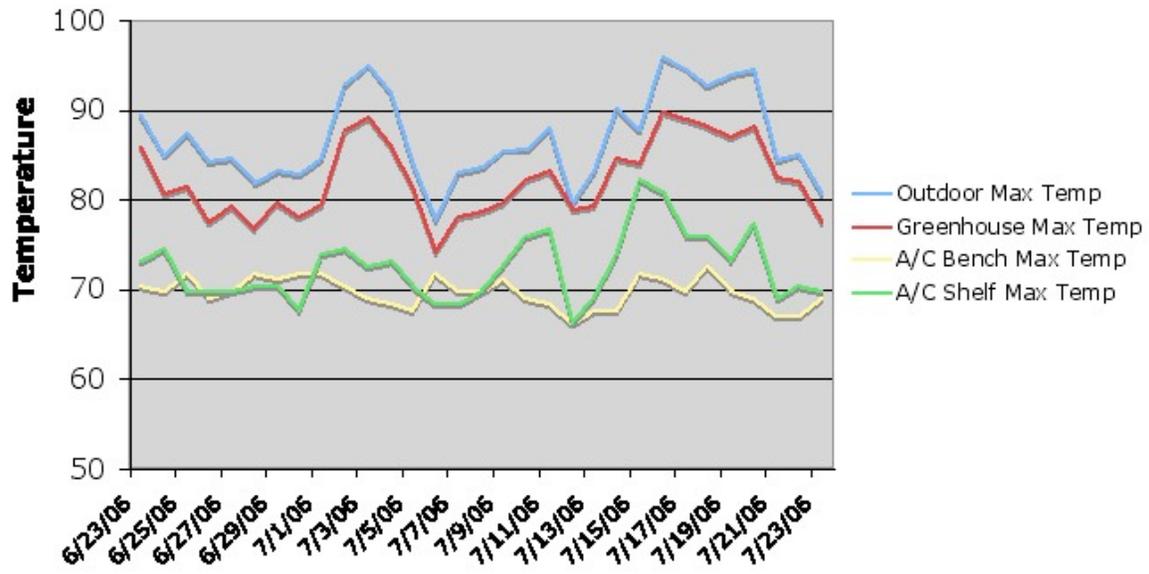


Figure 5. Daily maximum temperatures over thirty days in the modified growth compartments, as compared to outdoor and greenhouse temperatures.

Temperature of A/C Bench and A/C Shelf During Typical 72 Hours of Experiment

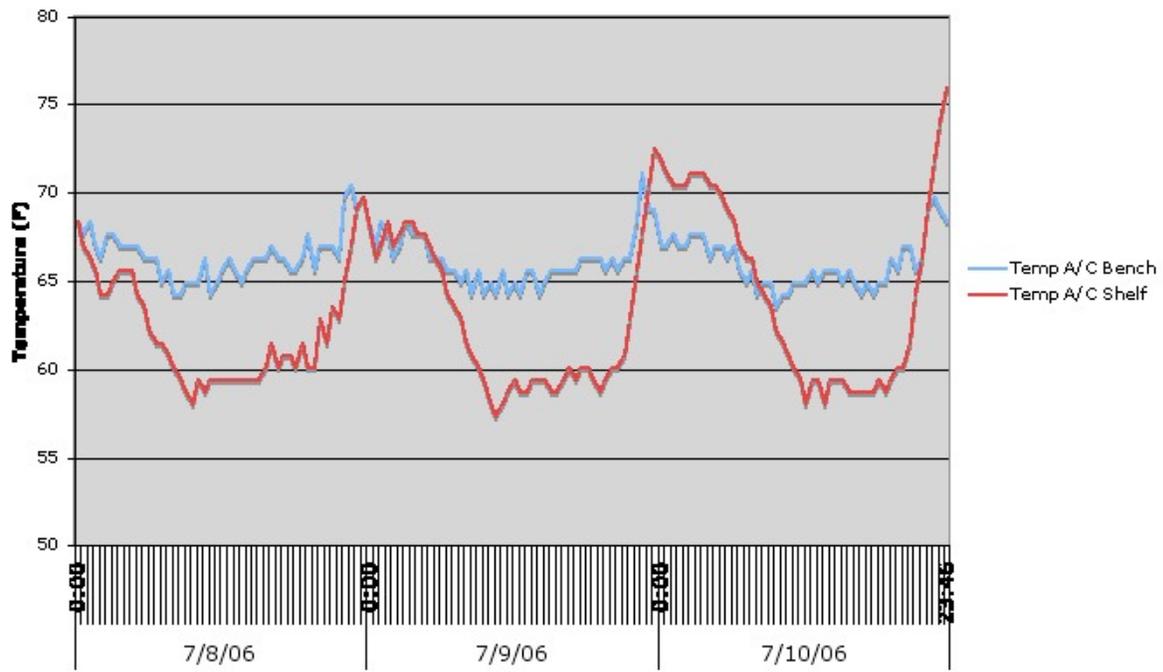


Figure 6. Temperatures over three day period in the modified growth compartments.

Relative Humidity of A/C Bench and A/C Shelf During Typical 72 Hours of Experiment

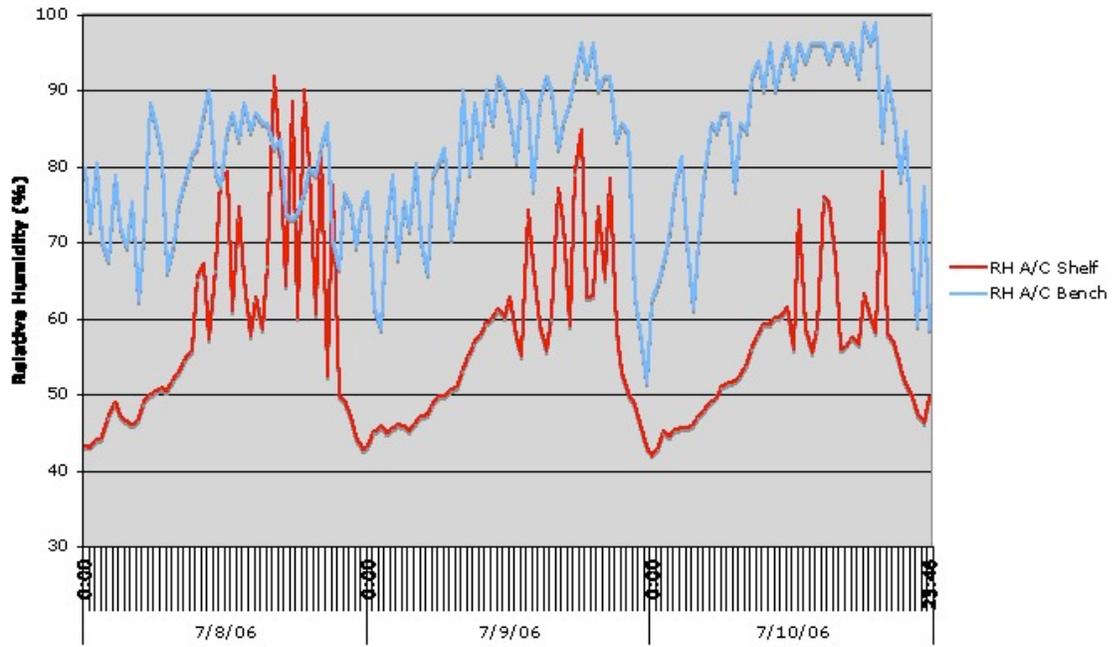


Figure 7. Relative humidity over three day period in the modified growth compartments.



Figure 8. Plant grown in modified plant bench (right) and in greenhouse outside of modified bench. Greenhouse plants had thinner flower stems that could not support themselves.



Figure 9. Flower stems from plant grown in modified plant bench (right) and in greenhouse outside of modified bench.