NEW HAMPSHIRE Plant Growers
QUALITY GARDEN CENTERS & GROWERS

NH Horticultural Endowment 2012 Annual Report

NH Plant Grower's Association * New Hampshire Horticulture Endowment
The Grant-Making resource for New Hampshire's Horticulture Industry

Why are Vermont scientists forever blowing bubbles?....
To find new ways to conserve energy in greenhouses.

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NEW HAMPSHIRE PLANT GROWERS ASSOCIATION
Horticulture Endowment Fund
Progress Report December 31, 2012

1. **Project title:** ***Novel Methods for Energy Conservation in Northern New England Greenhouses***

2. **Principle Investigator's name:** Dr. Margaret Skinner, Research Professor

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7. **Progress Report:**

Fig. 1. Bubble system in operation, filling the void with soap bubbles.

Funding from the New Hampshire Plant Growers Association, Horticulture Endowment Fund was received to support research to refine and improve on the design of a novel energy conservation system using soap bubbles to insulate a plastic-covered gable/hoop style greenhouse. This is a unique device that generates soap bubbles to fill the space between the two layers of plastic covering the house (Fig. 1). Energy efficiency for this novel system is being compared with a thermal energy curtain (Fig. 2) and an unimproved greenhouse. These systems were installed in October 2010 in separate greenhouses at a commercial operation in Vermont. Monitoring of various environmental and energy use factors is underway to measure the effectiveness of both systems under real-world conditions. The bubble insulation system is not an off-the-shelf product and has been somewhat challenging to put into operation. It was necessary to adapt it for use in the test greenhouse.

Fig. 2. Thermal curtain after installation.

Project Objective: Redesign aspects of the bubble insulation system and implement improvements to enhance system effectiveness.

A. **Progress on the Objective.** Three major problems with the bubble system were identified last year that needed to be redesigned to improve the overall operation of the system and to enable it to run over the growing season. These were the focus of this project over the first 6 months of the project: 1) Leakage of soap solution along the gutter; 2) Attachment of the foam generators; 3) Support for the greenhouse plastic over the foam generators. The improvements we made enabled us to operate the system throughout January and February of 2012.

Several unforeseen issues associated with the bubble insulation system surfaced this autumn (2012) that required our immediate attention to get the system back in operation. First, it was critical to replace the plastic covering the bubble greenhouse to reduce soap solution leaks due to small tears that occurred over the last year. We enlisted a specialist from Canada, who worked previously on this system, to help with putting the plastic on to ensure it was done correctly (Fig. 3). As a result of his expert assistance, we learned the importance of the degree of tightness of

the plastic necessary. This eliminated a past problem we have had to keep the two layers of plastic inflated when the system is not in operation. It also reduced the volume that must be filled with soap bubbles when the system is operating, which minimizes leakage and shortens the time required to fill the system.

The second issue that arose was mechanical. We discovered that at the height of the hot spell during the summer, the exhaust fans in the greenhouse were accidentally turned off. The heat inside the greenhouse reached over 150° F. When we started the system in September, it didn't work. After a detailed evaluation of the system components, we discovered that the high internal temperature in the greenhouse resulted in damage to the O-ring within a critical valve (Fig. 4). This valve was replaced and the system again is operating properly.

Fig. 3. Replacing plastic on bubble system greenhouse; Canadian expert installing splines (left); UVM and Claussen employees rolling out plastic (right).

The third issue we dealt with arose as a result of replacing the plastic. Because an effort was made to attach the plastic tighter over the frame, the soap solution tended to pool at the hip of the greenhouse, rather than draining back to the tank. This reduced the efficiency of the soap solution and increased the chance of leaks. In previous years we had placed a foam separator between the two layers of plastic that was attached with a screw through the bottom layer of plastic. This resulted in leaks which could not be stopped. Therefore it was essential to design a system that did not require attachment through the plastic. Several approaches to address this issue were devised. The first approach was to attach a black tube to the greenhouse frame below both layers of plastic. To prevent tearing of the plastic, we attached a layer of EPDM plastic over the tube (Fig. 5). Though this did allow some drainage to occur, when the system was in full operation, fluid continued to pool up. We next devised a tube system using pieces of black tubing placed vertically along the hip of the greenhouse between the two layers of plastic. These were designed to allow a channel for the fluid to move across the hip frame (Fig. 6.). The tubes are not attached to the wooden frame, but are held in place by the tension from the plastic. To date this device appears to have eliminated the problem. Because they sometimes become dislodged if there are heavy winds, a notch has been cut in the middle of the tubes so they remain in place.

Fig. 4. Hayward valve that failed due to high heat.

Fig. 5. Device for preventing fluid pooling at the edge of the greenhouse (left to right); black tube attached to hip frame of greenhouse, EPDM plastic covering tube; pooling of the soap solution that continued to occur.

Fig. 6. Black tubing placed vertically between the two layers of plastic, which effectively eliminated the pooling problem.

The fourth problem we encountered was linked with the soap bubble solution. In previous years we had used solution donated by the company. It was a slightly different formulation, but it was more cost effective in the experimental stage to use up this material. This fall we prepared fresh solution using the new formulation. This included adding Carbowax, a substance that serves as an antifreeze. The suggested concentration for Carbowax was 10%, which provided freeze protection to 26° F. Given the cold temperatures that occur in Vermont, we increased the concentration to 40% to provide protection to -5° F. We were alarmed to observe that the Carbowax significantly altered the quality of the bubbles produced. Bubbles made from the soap solution with a high concentration of Carbowax were very runny and degraded quickly. This was surprising to us given that we had been told that Carbowax improved the quality of the bubbles. A special apparatus was devised to allow us to test different soap mixtures in the laboratory at a range of pressures (Fig. 7). We ran a series of tests with different Carbowax concentrations and found that the standard 2% soap solution with no Carbowax produced the best suds, i.e., bubbles of small diameter making a dense white stream. The 2% soap with 40% Carbowax, which would provide protection to -5°F produced large-diameter bubbles that came out in a loose watery stream. A 2% soap solution with 10% Carbowax, which provides protection to 26°F, proved to be the best. The bubbles were of a small diameter, and produced a dense stream of suds. After further discussion with the Canadian experts, we learned that even if some freezing of the solution occurs, it will not harm the plastic, and will melt quickly at day break with exposure to the sun.

Fig. 7. Apparatus to test the quality of soap bubbles at different Carbowax concentrations (left to right), gauges allowing us to control pressure; good quality bubbles produced with a 2% soap and 10% Carbowax solution; poor quality bubbles produced with a 2% soap and 40% Carbowax solution.

B) Significant results, accomplishments, and lessons learned.

Results relative to gas usage and thus cost during the 2012 growing season were summarized, which provide additional insights into the respective value of the two energy conservation systems (Tables 1, 2). These results demonstrate that some savings in gas usage were realized with both energy conservation measures, though, differences between the bubble and curtain systems were not significant. We believe that further improvements to the bubble system made this fall will further increase the savings. In particular, last year, because the quality of the bubbles was not as good as they are now, the void between the two layers of plastic was not filled to the top. This reduced the insulation potential of the system. The soap solution we are now using produces drier bubbles that tend to expand throughout the space which reduces the time required to operate the system over night and increases the insulation capacity of the system.

Table 1. Cost of gas used in the three demonstration greenhouses

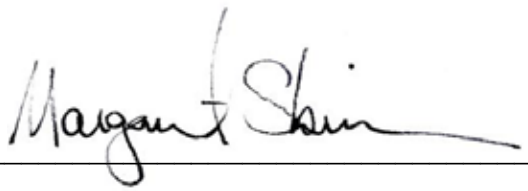
Total cost of gas used each month in each greenhouse			
Month	Curtain House	Bubble House	Control House
January (1/17/12 – 1/31/12	$389.31	$331.05	$511.02
February 2012	$554.14	$490.69	$789.79
March 2012	$404.70	$329.60	$571.73
Total	$1,348.14	$1,151.34	$1,872.54

Table 2. Comparison of dollar savings from gas use in the three demonstration greenhouses

Dollars saved in gas usage each among the greenhouses			
Month	Bubble vs Curtain House	Bubble vs Control House	Curtain vs Control House
January (1/17/12 – 1/31/12	$54.38	$200.69	$146.31
February 2012	$63.45	$299.10	$235.65
March 2012	$75.10	$242.13	$167.03
Total	$192.93	$741.92	$549.00

As discussed in detail above, several aspects critical to the operation of the bubble system needed attention to keep the bubble insulation system in operation. These have been the focus of our efforts over the past 6 months. We replaced the two plastic layers over the greenhouse to reduce fluid leakage. As a result of the expert assistance we enlisted, we learned the importance of tightening the plastic over the structure. This eliminated a past problem we had with keeping the two layers of plastic inflated when the system is not in operation. It also reduces the volume that must be filled with soap bubbles when the system is operating. This minimizes leakage and lessens the time required to operate the system. The faulty Hayward valve was replaced, and an O-ring replacement kit was purchased to repair the broken one which can be used as a spare. We learned that the bubble system is somewhat sensitive to high temperatures, and it is thus critical to check the greenhouse throughout the year, even when it isn't in operation. The devices we installed to allow draining of the fluid to the tank appear to be working, though their long term effectiveness will only be determined with prolonged operation of the system. We learned that the concentration of the soap solution is critical to the quality of the bubbles produced. Now that we have a testing apparatus, we can conduct further tests to assess how the bubbles respond to temperature and light. Most importantly, we learned the complexity of the soap bubble system for greenhouses. Though it appears to provide excellent energy conservation, it remains an experimental system that needs further research and development before it could be commercialized. We have communicated this to the current owner to the rights of the system. We continue to receive enquiries from growers who are interested in installing a system in their greenhouses. At this time we do not advise them to do so, until further modifications to the system are made.

D) Future plans: We intend to continue this project in the coming year and will record data on energy conservation in the three greenhouses to obtain more data on the effectiveness of the two test systems. We also hope to host a demonstration day in the summer or fall of 2013 to show growers region-wide how these systems work.

Signed. 

Date. December 31, 2012

NH Horticulture Endowment

Financial Report: 1/1/12 through 12/31/12

Checking account balance:	1/1/12	$10,843.15
Income		
Fafard Soil Bag fundraiser		$2,250.00
NHPGA dues donations		$0.00*
		$2,250.00
Expenses		
Admin. Asst.		$465.00
Grant		$5,000.00
Office supplies, postage, Printing		$223.36
		($5,688.36)
Income Less Expenses:	**($3,438.36)**	
Checking Account Balance:	12/31/12	$7,404.79
MFS Mutual Fund Value:	1/1/12	$18,437.58
MFS Mutual Fund Value:	12/31/12	$20,510.94
Income (loss):		$2,073.36
NH Charitable Foundation:	1/1/12	$107,653.91
NH Charitable Foundation:	12/31/12	$119,205.69
Income (loss):		$11,551.78
Net Gain (loss)	1/1/11 – 12/31/12	$10,186.78
Total assets	1/1/12	$136,934.64
Total Assets	**12/31/12**	**$147,121.42**

**$975.00 donated to NHHE via NHPGA still to be transferred.*

NHPGA Container Mix Program:

NHPGA members raised over $2,100 dollars in the past year for the NHHE Endowment fund. One dollar from the sale of every bag goes to research that benefits NH Growers. To learn more about selling the container mix please contact Peter Gagnon, Sungro Horticulture, 860-428-8470, peterg@sungro.com

NHPGA Container Mix has a new look!

Donors to Date:

Pacesetting ***$10,000 plus***

*Pleasant View Gardens

Leading ***$5,000 to $9,999***

First Pioneer Farm Credit

*Ledgewood Farm

*Newton Greenhouses

Major ***$3,000 to $4,999***

Ball Seed Company

*D.S. Cole Growers, Inc.

*Griffin Greenhouse and Nursery Supply

New Hampshire Landscape Association

*Spider Web Gardens

*Van Berkum Nursery

W.H. Milikowski, Inc.

Primary ***$1,000 to $2,999***

*Bailey Nurseries, Inc.

Cavicchio Greenhouses, Inc.

*Champions of NH Farms/ NH Dept. Of Agriculture

*Deerfield Gardens

*Demers Garden Center

Durham Garden Club

Edgewater Farm

*Garrison Hill Florists, Inc.

*Goldstar Wholesale Nursery, Inc.

*Hortica *(formerly known as Florist's Mutual Insurance Company)*

*Nancy Carlisle Interior Plantings

*Outdoor World

*Prides Corner Farm, Inc.

*Rimol Greenhouse Systems, Inc.

*Rolling Green Nursery

*Round Table Farm Greenhouse

*Stratham Circle Nursery and Landscape

*Trugreen Landcare *(Formerly *Coronis Landscaping, Inc.)*

Wentworth Greenhouses

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Supporting *$500 to $999*

*Berger Peat Moss, Inc.
*Berger's Springledge Nursery
*Bergevin's Greenhouse
*Charter Oak Landscape & Nursery Sales
*Davis Brook Farm
*Ellison's Greenhouse
McSherry's Nursery
*Kathan Gardens
Millican Nurseries
* Nancy E. Adams
The Mixed Border Nursery
*New England Anemones
*Wayside Farm

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*Bayberry Nursery
*Belknap Landscape Co., Inc.
*Blackberry Farm
*Colby Hines Contracting
*Davis Engineering
*Deer Cap Greenhouse
*Fred C. Gloeckner Company
*Gillyflower Glen
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*Ledgeview Greenhouses
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*The Green Thumb of North Haverhill
*Uncanoonuc Mt. Perennials
*Weir Tree Farm

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*Blue Star Peat Moss
*Bly Farm
*Boulder Farm
Brookhill Lighting & Landscape
*Callahan's Greenhouse
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Eagle Mountain Evergreens
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Goudreault Farm
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Mathew Kobs
*Meredith Gardens
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New England Heather
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*Revay's Garden Center
*Ronald B. Laurence, P.E. Consultant
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