H o r t i c u l t u r a l E n g i n e e r i n g

Volume 14 No. 3 May 1999

Website: www.cook.rutgers.edu/~roberts/

Bedding Plant Season Underway

The Spring bedding plant season is well underway with many producers having started to sell. From all accounts it looks like another banner year although there have been some reports of lower pricing to move product. Gene McCormick in his opinion column of the April, 99 **Greenhouse Business** magazine stated that some feel that the selling-for-less mentality created by large marketing chains is adversely affecting some growers in the Northeast. He quotes a New York grower as saying, "We still have a good customer base because they know we give them great stuff. But it's tough to sell a new account when all they see is the price list." McCormick indicated that their research shows that 77 percent of the growers in the Northeast felt they were getting fair wholesale prices and 15% of the growers were unhappy with the prices being paid.

We will soon know the answer to the many questions of profitability as the season matures. From previous experience our growers have always demonstrated an amazing ability to conquer difficult decisions.

Extra Collection Site Added in Atlantic County

Secretary Arthur Brown has announced that a third collection site has been approved for the 1999 greenhouse and nursery film collection and recycling program. The new site, operated by the Atlantic County Utilities Authority is located in Egg Harbor Township and will begin accepting film from New Jersey growers immediately. "The new site will better serve many growers from the coastal area,"

Continued in next column

Extra Site Added continued

Brown said. "Since almost 90 percent of the film generated by the NJ greenhouse industry comes from the southern portion of the state, we really needed this additional site."

The other two sites are located in Deerfield and Millville in Cumberland County. The collection program runs through June 1, 1999.

The new site will accept film Monday through Friday from 7:00 am to 5:00 pm. Material collected has to be clean and conform to the Grower Collection and Bundling Guidelines published by NJDA.

For copies of the guidelines and additional information contact Karen Kritz at the NJDA 609 984-2506 or e-mail at agukrit@ag.state.nj.us or the New Jersey Nursery and Landscape Association at 609 291-7070 or AT Plastics at 1-800-661-3606.

Website of Interest

This Issue of Horticultural Engineering like previous ones is available on the web at:

www.cook.rutgers.edu/~roberts/

Our hope is that many of you will want to make use of the website and eliminate the need for us to send you a hard copy.

Please let us know so that we can save the duplicating, postage and handling costs in our depart*ment,* *Bill Roberts*

Composting Field Guide Available

Composting continues to gain momentum as an environmentally sound way to stabilize and reduce the volume of agricultural and municipal wastes. A new publication from the Natural Resource, Agriculture, and Engineering Service (NRAES) is designed to help agricultural producers in the day-to-day management of an on-farm composting operation.

The Field Guide to On-Farm Composting ($14.00 plus S&H/sales tax, 128 pages, April 1999) is a handy reference guide that helps on-farm composters find practical information about composting quickly and easily. It answers common questions such as: What is the optimum moisture content and bulk density of a compost mix? Why is my compost operation odorous and how can I control the odor? How long does it take to compost poultry mortality? How much compost can I land apply? The field guide was developed as a companion to the best-selling NRAES publication On-Farm Composting Handbook (NRAES-54) and is available from NRAES. It will be a valuable educational tool for cooperative extension educators and agricultural advisors.

The Field Guide to On-Farm Composting is intended to be used in the field. It is compact, spiral-bound, and printed on durable glossy paper with a laminated cover. Colored chapter tabs make finding a specific chapter a snap. The text is supplemented with 17 tables, 24 illustrations, commonly used equations, bulleted lists, and many sample calculations for at-a-glance referencing. Other highlights include 24 color photos and a case study written by technical staff of the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS); the study discusses results of agricultural field trials using compost on highly erodible soils in the state of Texas.

Continued from previous column

The field guide contains six chapters. Chapter 1, "Operations and Equipment," reviews composting operations, from raw material preparation to compost storage, and discusses equipment needed for on-farm composting. Chapter 2, "Raw Materials and Recipe Making," presents descriptions and characteristics of the most common raw materials used for on-farm composting and includes easy-to-read tables and standard formulas for developing a successful recipe. Examples of recipe formulation are included. A special section reviews the basics of recipe making for first-time composters. Chapter 3, "Process Control and Evaluation," discusses steps for maintaining the necessary biological conditions in a compost pile and reviews sampling, testing, and troubleshooting procedures. A lengthy troubleshooting guide is included at the end of the chapter. Chapter 4, "Site Considerations, Environmental Management, and Safety," presents basic requirements for siting a farm composting operation, including area and buffer zone requirements; reviews common nuisances such as odors, pests, runoff, and leachate and outlines procedures for controlling them; and discusses important safety issues, including worker health. Chapter 5, "Composting Livestock and Poultry Mortalities," explains procedures for planning, constructing, and managing an animal-mortality composting operation. A discussion of pertinent environmental and regulatory issues is included. Chapter 6, "Compost Utilization on the Farm," examines important characteristics and benefits of farm compost and presents a brief overview of the most common uses of compost on the farm. Equations and tables for determining appropriate application rates are included as well.

The Field Guide, NRAES-114, is available for $14.00 per copy plus shipping

Continued from previous page

and handling. Please write to NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, NY 14853-5701. Shipping and handling for one copy is $3.75 within the continental United States. New York residents, add 8% sales tax (calculated on both the cost of publications and the shipping and handling charges). If ordering more than one book or if ordering from outside the United States, contact NRAES for shipping rates and possible quantity discounts. Orders from outside the United States must be prepaid in U.S. funds. All major credit cards are accepted, and checks should be made payable to NRAES. For more information or a free publication catalog, contact NRAES by phone at (607) 255-7654, by fax at (607) 254-8770, or by e-mail at nraes@cornell.edu. To learn more about NRAES, browse through our entire catalog, and order books on-line, visit our web site at << www.nraes.org >. NRAES information is also available from your editor at similar charge although time required for shipment may be longer.

EVAPORATIVE COOLING

Evaporation of water requires the energy of conversion from a liquid to a vapor, which is approximately 1050 Btu/pound of water. In evaporative cooling systems, this energy is extracted from the air, which is cooled as it evaporates the water in the system. Evaporative cooling has been used successfully for many years.

The system outlined by Acme uses fans on one side of the greenhouse and wetted pads mounted on the opposite side of the greenhouse at the ventilation inlet. The pads are wetted by water flowing down through them by gravity. Air is drawn through them, evaporating some of the water and causing the air to be cooled nearly to the wet bulb

Continued in next column

temperature. These systems are particularly successful in areas of low humidity, where 10^{o} F cooling is not uncommon. Problems with this system include maintenance of the system, depending upon the quality of water available for cooling. Salt buildup is a significant problem in some geographical areas.

Very high-pressure fog systems are also used successfully for greenhouse cooling. Since the fog nozzles are placed throughout the greenhouse, this system has the advantage of evaporating water throughout the greenhouse, rather than depending upon the evaporation that occurs only along one wall, as in the wet pad system. The fog systems tend to be expensive because of the large number of nozzles required and the expensive high-pressure pump (500-900 psi) utilized to create extremely fine droplet sizes. Water treatment is essential for good performance of fog systems. Biological, chemical and mechanical buildup within the nozzles can cause system failure.

This section on evaporative cooling is taken from E213, Environmental Control of Greenhouses. The publication also contains additional information on environmental control including heating and cooling applications. Copies are available from your editor at modest cost.

Enjoy your Spring

Bl

ooming Sales!!

Professor Will Carlson recently stated that the economy continues to be strong. Carlson, at Michigan State University recently stated that at the beginning of the 20th century total sales amounted to $20 million. By the end of the century they will have rung up at $2.5 billion. He attributes much of the industry's growth to the introduction of many new hybrids in the late 1950's.

STORAGE PRINCIPLES AND QUALITY ASSURANCE

William J. Roberts

Crops that have been harvested are still biologically active. Heat of respiration and other biological processes continue after harvest with the rate of this activity dependent primarily upon temperature. Respiration is shown by the following equation: $C_6H_{12}0_6 + 6\ 02 = 6C0_2+6H_20 + HEAT$. This reaction occurs at different rates dependent upon temperature. In this equation the oxygen of the air combines with the carbon of the sugars to ultimately produce carbon dioxide. We can limit the activity of the reaction by:

- lowering the temperature,
- reducing the oxygen level
- increasing the $C0_2$ level.

There are several key factors important in ensuring life after harvest for fruits and vegetables Several of these will be discussed in this presentation. These include:

- Initial product quality, go-gi! (garbage in – garbage out!!)
- precooling most helpful to overall quality and storage life.
- storage temperature and its relationship to respiration
- relative humidity
- air circulation
- stacking and spacing

TEMPERATURE

Temperature is one of the most important factors to control. Controlled environment or CA storage is often used in concert with temperature control. Temperature reduction retards:

- aging due to ripening
- softening
- textural and color changes
- unwanted metabolic change

Continued in next column

Continued from previous column

- respiration of heat
- moisture loss/wilting
- spoilage due to bacteria

Refrigerated storages are the most prominent method used to reduce respiration. Their construction requirements are well known including insulation requirements for different storage requirements and building materials which are long lasting and maintenance free. Refrigerated storages do the following:

- Retard metabolic activity
- reduce aging due to ripening, softening and reduce color changes
- Maintain high humidity levels and reduce moisture loss
- limit spoilage due to microbial activity, bacteria, fungi,
- limit sprouting of potatoes, sweet potatoes etc.

WHAT PLACE DOES HUMIDITY HAVE IN REFRIGERATED STORAGE?

Relative humidity is defined as the ratio of the amount of water in the air to the amount of water the air could hold if saturated. Air at 60^0F versus 40^0F at the same relative humidity contains more actual water.

The relative humidity of any storage directly affects the quality and keeping characteristics of the commodities being held. If the relative humidity is too low, shriveling, weight loss and wilting occurs. Almost all products require high humidity for optimum storage conditions. Generally 85 to 95% is recommended to retard softening and moisture loss. Some vegetables such as squash and sweet potatoes and some nuts require lower humidity. USDA Handbook #66 The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks gives the complete specifications for nearly all stored agricultural products.

Continued on next page

Continued from previous page

One of the most important factors which allow a grower to maintain high humidity is the design of the refrigeration cooling coil or evaporator. A good design will call for a large evaporator surface and a small temperature difference between the coil operating temperature and the design holding temperature of the refrigerated storage. A smaller evaporator will require a larger temperature difference (delta T). The smaller, colder coil surface will condense out large quantities of water from the air passing through the evaporator, resulting in lower relative humidity in the storage. Larger evaporator coils are more expensive, of course, so there must be a trade-off between cost and evaporator size for good design. For instance if air is cooled over a coil to 30^0F and the surface temperature of the coil is 25^0F the relative humidity of the air leaving the coil will be 78%. If however, the same conditions exist but the coil temperature is 27 ^{0}F the relative humidity of the air leaving the coil will be 89%. This is a much more desirable situation which is created by having only a 2^0F difference in coil temperature (27^o-25^0).

Loss of water or transpiration in the stored crop is a major cause of deterioration in storage. Water loss in apples stored at 37^0F is 1/2 per cent per week. This is unacceptable. Water loss not only results in weight loss, an important sales consideration in some crops, but in less attractive produce of poorer texture and quality. The vitamin C content of green vegetables decreases more readily when they are stored under conditions favorable to wilting rather than at optimum humidity.

The rate of transpiration can be reduced by lower temperatures, higher humidities, reduced air movement and by protective packaging in some situations.

Continued in next column

Continued from previous column

Other important items of design include tight storages with doors of proper design. Another important provision is adequate insulation to avoid condensation on the walls and ceilings which also lowers the relative humidity of the storage. Dripping from condensation also causes free water on the surface of the product being stored, an open invitation for disease and fungus to develop.

Stacking to ensure air circulation helps distribute the heat of respiration given off by the crop being stored. Very high velocities are to be avoided. If precooling is not used the crop can be more tightly stacked after field heat has been removed.

Post-Frame Building Handbook

NRAES-1, one of the earliest publications of the Natural Resource, Agriculture, and Engineering Service, presents in a clear, easy-to-follow style the latest design considerations and construction methods for post-frame buildings. These designs are often excellent choices for the storage and work space needs of greenhouse operators. This 78 page publication is a major revision of the original Handbook edited in 1984. The handbook is enhanced by 60 illustrations and 31 tables. It also provides essential information for the preliminary design of modern post-frame buildings.

NRAES-1 can be ordered from your editor or from NRAES for $12.00 plus $3.50 for single copy shipping and handling costs. Their address, as indicated in the article on the Field Composting Guide is;

NRAES
Cooperative Extension
152 Riley-Robb Hall
Ithaca, NY 14853-5701

Special CCEA Conference
ACESYS III
"From Protected Cultivation to Phytomation"
Friday July 23, 1999
Cook College Rutgers University
New Brunswick, NJ USA

Conference Chair Dr. Gene Giacomelli
732 932 9753
732 932 7931 Fax
giacomel@bioresource.rutgers.edu

The Conference will include a Phytomation Special Lectures Forum, comprised of an outstanding international field of experts in controlled environment agriculture, and chaired by Dr Tadashi Takakura of Nagasaki University and Dr. K.C. Ting, Chair of the Bioresource Engineering Department of Rutgers University.

The morning Forum will provide a foundation for the day's program, offering a firm background and promoting the discussion for visioning of Phytomation which will follow in an afternoon program. The Forum will be open to include growers, research, industry and interested academics.

The special CCEA afternoon session will also include several speakers and a discussion session. The entire conference should be of especial interest to those interested in planning the future of Phytomation as it develops from controlled environment agriculture.

The day will conclude with an evening retirement banquet in honor of Professor William J. Roberts.

COOPERATIVE EXTENSION
COOK COLLEGE
RUTGERS, THE STATE UNIVERSITY
NEW BRUNSWICK, NJ 08901

Distributed in cooperation with US Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 30, 1914. Cooperative Extension Service work in agriculture, home economics and 4-H. Zane Helsel, Director of Extension. The Cooperative Extension Service provides information and educational services to all people without regard to sex, race, color, national origin, age or handicap. Cooperative Extension is an equal opportunity employer.

Of all the words of tongue and pen, the saddest of all , it might have been.

HORTICULTURAL ENGINEERING

William J. Roberts Editor
Extension Specialist
Bioresource Engineering Department
Rutgers, The State University of NJ
George H. Cook College
20 Ag Extension Way
New Brunswick, NJ 08901 - 8500
Comments, questions and suggestions are welcomed.
Phone 732 932 9534
email
roberts@bioresource.rutgers.edu
website