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Chasing Potassium: How I Learned to Keep my Tunnel Tomatoes Fed for Optimum Packout

Steve Bogash, Penn State Regional Horticulture Educator

Every season is different and sometimes, even what we believe are minor changes in how we grow a crop, produce major ripples in production. In 2009, the farm staff at the Penn State Southeast Research and Extension Center (SEAREC) near Lancaster, along with a group from Haygrove, installed a Haygrove Super Solo. It is 200' long and 25' wide tunnel with roll-up end walls and push-up sides.

I've managed tomatoes, peppers, greens, and cut flowers in tunnels in the past, but generally under Tufflite IV or more recently Solarig 172 coverings. The Haygrove Super Solo package ships with a diffusion plastic, Luminance THB poly. The diffusion plastic manipulates light very differently than either of the other plastics. Sunflowers that grow 6-7' tall in the field or under Tufflite IV grew 8-10' tall in the Haygrove. I used a Spectrum PAR light meter (this measures only the wavelengths of light that plants use) under the Luminance THB, and in a nearby tunnel covered with Tufflite IV in late morning and again in the early afternoon over several days. At each reading, the quantity of PAR light directly on the sensor was approximately 6-7% less under the Luminance poly. When I rotated the sensor off of the direct axis with the sun, the levels under the Tufflite IV fell very quickly while the Luminance poly spread the light very widely. The quantity of PAR radiation was nearly the same until the sensor was turned well away from the sun. I believe that this spreading of the light resulted in more light on the lower leaves and over more leaf surface than is typical of most greenhouse coverings. This piece of information seemed to fall into the category of just an interesting anecdote until we started managing the nutrients in the Haygrove for the tomato variety trial. This project was funded by the PA Vegetable Growers Association.

Growing great tomatoes that are full flavored and have low losses in the packing house requires keeping tissue potassium levels above 3%. From the first blossoms to the last harvest, tomato plants (and peppers as well) require huge amounts of potassium to produce the most flavor and prevent yellow shoulders / gray wall. Although I look at every nutrient level, those most important to packout are:

1) Nitrogen too high: tissue N levels should be at about 4% as fruit are developing. Higher levels can create soft fruit, more foliage, and fewer fruit.
2) Potassium too low: tissue N levels need to be above 3% for tomatoes and peppers to produce the highest quality fruit and to keep creating new blossoms.
3) Calcium and Magnesium levels all over the place: Ideally Ca should be at about 3% and Mg at 0.8-1%. This prevents cracking and produces fruit that are tough enough to handle harvesting and packing.

The cool, cloudy weather of 2009 was challenging for everyone and all crops, but tomatoes really seemed challenged. Although we fed the tomatoes a high K soluble fertilizer (Miller 9-15-30 NutriChem and Stollers 5-10-27 Urea Mate) from the first

blossom, we simply could not keep up with the plants demands. Every tissue test indicated higher demand for K. We kept adding more high K fertilizers to the injector and watched our levels fall again at the next test. Our first tissue test indicated that we were at 3.1% K at first blossom, then went to 2.7% K two weeks later, then 2.4% K two weeks later, then 1.91% K two weeks later and were picking far too much fruit with yellow shoulder and related symptoms. It was not until we started twice per week foliar feedings with NutriK at 2oz/gallon in addition to the injected fertilizers that we started seeing tissue K levels move back up to tolerable levels.

I believe that the combination of the Luminance plastic in the tunnel with tomato varieties that have high production potential produced a demand for the extra potassium. In retrospect, although I've always recommended bi-weekly tissue testing to growers due to the cost of the tests, I now recommend weekly sampling. Also, like most of the growers that I work with, I've always fed nutrients either once per week or at most twice, pushing production in a tunnel with diffusion type plastics may require moving to a constant feed program.

Some growers have questioned the economics of a frequent testing, high potassium program, but even conservative yields and sales prices indicate that tomatoes are worth the extra effort. Follow my thinking below:

1) Assume 1 acre of tomatoes with plants spaced 18"apart with 6' between rows. This creates a plant population of 4,840 plants per acre.
2) With minimal attention to details like tissue testing and nutrient application, you should readily harvest a very conservative 1,600 #25 boxes.
3) At even $15.00 / box, your gross is $24,000.
4) Even after the expense of boxes, plants, plastic mulch, harvest and the like, 8-10 tissue tests are inexpensive insurance for a good packout.

Using the logic above and factoring in the higher prices that early harvests bring, constant tissue testing in tunnel production is simply a requirement.

Use of Plasticulture for the Production of Melons

Mike Orzolek, Penn State Horticulture

Since cucurbits in general and melons specifically love warm temperatures, production of melons (cantaloupe and watermelons) in much of Pennsylvania is a challenge both from the standpoint of temperature and moisture. Melon plants stop growing below 45°F and will have a difficult time maturing fruit when average night temperature drops below 50°F. Optimum growth of melon plants is between 75° and 85°F daytime temperature. For the average grower in Pennsylvania growing on bare soil, the planting date for melons is generally between May 20 and June 15, assuming that there will not be extremes in day and night temperatures. While mature cantaloupe and watermelon plants are somewhat drought tolerant, they require consistent soil moisture levels (80% of available soil moisture) after seeding or transplanting and until they reach the 10-12 leaf stage of growth. On the other hand, excess rainfall 2 weeks prior to fruit harvest will dramatically reduce soluble sugars and fruit quality. The use of plasticulture will help eliminate/prevent these environmental stresses on melon plants during the growing season.

For the production of high quality melons, the use of raised beds, plastic mulch, drip irrigation and row covers will insure success and consistent marketable yields. The use of plasticulture in the production of melons will: 1) increase soil temperature 8° to 12°F warmer than bare soil, 2) increase/maintain soil water holding capacity, 3) reduce/eliminate weeds, 4) maintain/increase soil tilth and 5) reduce/eliminate fertilizer and pesticide leaching under the bed. I will discuss the individual components of plasticulture in the following sections below.

Raised Beds – Making a 6 to 8 inch raised bed prior to applying plastic mulch in the field helps to a) increase soil temperature, b) produce a tight fit of plastic on the soil surface, c) prevent plant/fruit damage from excessive water (heavy thundershowers), d) reduce soil erosion when beds follow soil contour and e) helps to produce a higher quality, cleaner fruit. Many equipment manufacturers sell a multi-function machine which will make a raised, pressed bed, lay the ag film snugly on top of the bed and also place drip tape at a desired depth in the bed at one pass. In addition, a fertilizer applicator can be placed on top of the bed maker/mulch applicator to add nutrients into the bed.

Plastic Mulch – Since plastic mulch increases soil temperature, soil moisture and maintains soil tilth, seeding or transplanting melons within 2 to 5 days after application of the plastic in the field is recommended. Plastic film can be purchased at a thickness of 0.3 to 1.5 mil, embossed or smooth and colors of clear, white, black, blue, IRT green, IRT brown, red, yellow and silver. The plastic film you purchase can be tailored to your needs based on crop being grown, number of crops to be grown on the film, length of time to be left in the field and pest elimination requirements. The thicker the film, the longer it can be left in the field: 1.5 mil plastic will last two years/multiple crops in the field. However, in general, the thicker the film the higher the cost, unless the purchase is an ultra-thin plastic film 0.3 mil or less. Embossing imparts more elasticity/stretchability compared to the smooth plastic film. As to color, melon plants will produce higher early

and marketable yields on IRT green, blue or silver compared to the standard black. The silver mulch also repels aphids so that aphid vectored viruses are eliminated in the field.

Drip Irrigation – Water comprises 94% of melon fruit which would verify the importance of water in the growth and development of melon plants and fruit. Whether seeding or transplanting melons, application of water is extremely important to maintain soil capacity for germination of melon seeds or the regeneration of root and shoot growth of melon transplants. Drip irrigation is very efficient in directing water to the crop and not the weeds, reducing/eliminating foliar diseases, and injection of fertilizers and/or pesticides. Since many soils in Pennsylvania are silt loams to clay loams and generally have between 1.5% to 2.5% organic matter they tend to have relatively high cation exchange capacity (CEC), low to moderate water infiltration rates, and moderate to high water holding capacity. Because of these characteristics, growing melons on these soils and raised beds/plastic mulch is more effective when at least 40% of the fertilizer requirement is added preplant rather than totally through the drip irrigation system. Fertigation of nitrogen (approx. 7 to 10 lbs/A) after crown set fruit are harvested does help to increase fruit production and maintain plant health and vigor. Scheduling water application on measurement of actual soil moisture levels (irrometer or tensiometer) will help to maintain active plant growth throughout the growing season and high sugar, high quality fruit. Remember that soluble solids or sugars are translocated to the fruit within the last two weeks prior to the fruit being full slip. Application/reception of excessive moisture during this period of carbohydrate movement from plant to fruit will dramatically reduce the sugar level and overall quality of the fruit.

Row Covers – Since melon crops return a relatively high gross per acre and require warm temperatures both day and night, use of polypropylene row covers is both economical and productive. Applying row covers on the raised bed/plastic mulch after seeding or transplanting melons will increase both ambient and soil temperature resulting in increased plant growth, reduce/elimination plant dessication, maintain higher soil moisture levels, and exclude insect feeding on young plants. However, once female flowers are observed on plants, the row cover must be removed to allow for pollination by honeybees. While polyester row covers are available, the stiffness of the material compared to polypropylene will cause leaf abrasion and potential delays in fruit maturity.

Low Tunnels – In locations that are rather windy in the spring of the year and plant dessication is a principle cause of plant mortality, use of low tunnels will help both establishment and early production of melons. Low tunnels are usually 1-mil rolls of perforated (for ventilation) polyethylene stretched over metal hoops (no. 9 wire) placed every 6’ to 8’ over the row of melon plants. The tunnels are immediately placed over the row after transplanting and left in place until the afternoon high temperatures exceeds 85°F for 3 successive days.

Tips for Successful Melon Production with Plasticulture

Use raised beds (4 to 6'' high) when laying plastic in the field compared to flat beds to insure better water and nutrient management in the field.

When laying plastic in the field, make sure soil is at least 85% of water-holding capacity.

Wait at least 2 to 3 days after laying plastic mulch in the field before transplanting or seeding melons through the plastic.

After seeding and especially after transplanting melon plants through plastic mulch, monitor soil moisture levels underneath the plastic mulch and maintain moisture levels by use of drip irrigation system.

Monitor cantaloupe plants for health and vigor after making a postemergence herbicide application. If plants look stunted and chlorotic, consider applying a combination of nutrients and cytokinin.

Monitor melon plants for both cucumber beetle and aphid populations since both insect species can rapidly reproduce and vector viral or bacterial organisms to young melon transplants.

Remove row covers or mulches from low tunnels when the first female flowers appear in the field.

Place at least one active beehive per acre of production to insure pollination and fruit production.

Fertigate with low levels of nitrogen (5 to 7 lbs/A) throughout the growing season ending prior to your last fruit harvest. Consider alternating calcium nitrate with potassium nitrate.

Apply one pound per acre Boron pre-bloom stage either through the drip irrigation system or as a tank-mix with fungicide spray.

Reduce water application to melon crops within 2 weeks of the bulk harvest of melons in the field to improve soluble solid levels and higher fruit quality.

Plastofuel™: The Right Fuel for the Right Time, Which is Right Now!

William J. Lamont, Penn State Horticulture

There is something wrong with this picture: Natural gas and petroleum are processed into a usable and socially acceptable product called plastic. Plastic products run the gamut from plastic drip irrigation tape used by agricultural producers…to shrink wrap for wrapping a variety of products on a pallet…to the wrapper from your English muffins, complete with a little plastic tab. Locked inside these products is the energy value of the virgin petroleum or natural gas that made them, which may or may not be recycled and in many cases ends up being buried in a landfill. Does this make sense? Would you throw gasoline or fuel oil into a landfill? We are wasting this valuable fuel (not trash) that is right here above ground waiting to be utilized properly. How many more years are we going to continue with this Neanderthal thinking when it comes to plastics as a fuel?

At Penn State University we are dedicated to solving this problem which is indeed one of the world's major environmental problems.

Have you noticed all the media hype and press releases about alternative fuels and energy sources, such as ethanol, biomass energy such as switch grass, wind and solar energy just to name a few. Not speaking for or against these initiatives, but why not harvest the low hanging fuel fruit that continues to lie around the environment worldwide? The large consumer plastic waste stream is a potentially untapped fuel source and one that company that deals with solid waste management could build a positive public relations campaign around.

Each reader should think about all the plastic waste generated in your own household alone. What about non-recyclables, such as the plastic butter tub with the wider mouth than its base, or the plastic security package for the new tool you just bought? One friend of ours saved his non-recycled plastic waste, and in so doing it became a real eye opener for him to discover how much plastic he was wasting.

There is strong demand for recycling PET soda bottles, for example, which can be recycled into carpet. What about trash generated when you buy plants for the garden? These plants come in a plastic pot or plastic six-pack, and if you buy enough, the packaging also includes a plastic tray or flat to hold the six-packs. You can reuse the pots yourself, of course, and sometimes garden clubs or conservatories need them for plant sales, but tragically most recycling programs do not accept them.

The time has come to recover valuable energy from waste plastic by densifying it, thus making it easier to transport, then burning it cleanly at high temperatures to capture the fuel value trapped inside. You cannot do this, but the technology is here today, called Plastofuel™.

The Plastofuel™ process was invented at Penn State University in 1995 to densify waste plastics into a fuel nugget. The process, developed in the Department of Agricultural and Biological Engineering, aims to reduce waste plastic buildup on farms around the world. It can also be used to recover the energy in non-recyclable plastics. It works by forcing film plastic items, rigid plastic items, or both, through a heated dies, thus melting a thin jacket that encapsulates the pieces of plastic and dirt within the extruded material exiting the die. Sharp knives cut the extruded material into dense fuel nuggets that can be easily conveyed, stored and shipped. Plastofuel™ can be made either on the farm or in small industrial settings, thereby consuming the energy close to the source.

The benefit of this densification process is that it converts an annoying waste into a valuable fuel, with a minimum of energy expended in the process. Non-recycled consumer plastic food and beverage containers can also be used in the process. Many of the plastics not currently recycled can be used as feedstock. The unit can be set up at county or regional recycling centers suited to managing wastes.

With the spotlight on global climate change and energy self-sufficiency, it makes sense to capture the energy contained in waste plastics. Plastics once designed to benefit mankind can now be converted into fuel, which once again will benefit mankind by reducing our dependency on outside sources of energy. An added perk is that we can help clean up the environment.

The time has come.

Feel free to contact us if you are interested in learning more about this exciting project or being a part of the program.

Bill Lamont, wlamont@psu.edu

Farm Food Safety Sessions at the Mid-Atlantic Fruit and Vegetable Convention

Luke LaBorde, Penn State Food Science

On February 3 we will be having a morning farm food safety GAPs lecture session from 9-12.

That afternoon at 1:30 pm, we will also be having a group discussion on farm food safety. This is a good opportunity to hear about farm food safety issues from a variety of viewpoints and to provide your input. Representatives from the Pennsylvania Department of Agriculture, USDA and the Pennsylvania Food Merchants Association will be present as we discuss some of the challenges growers are having with new food safety requirements. Look for signs at the Convention for the room in which the afternoon discussion will be held.

Please plan to attend if you are interested in learning about this important issue.

Greens Production in High Tunnels

Mike Orzolek, Penn State Horticulture

There are several lettuce types and several hundred lettuce varieties that are commercially available for growers and differ by color, texture, maturity and head size. They include the following; Romaine - green and red, Bibb – green, Oakleaf - green and red, Butterhead - green and red, Summer Crisp (Batavia) - green and red and Baby lettuce mixtures - mild mesclun mix, spicy greens mix, braising mix. Depending on the location of the high tunnel, maturity of the lettuce variety is very important for scheduling production and implementing marketing plans. Lettuce types range in maturity from 42 to 58 days for full size heads. Baby lettuce types are ready from seeding to harvest in 28 to 30 days. Cooler air temperatures, below 40°F will slow growth of lettuce plants and increase time to maturity 7 to 10 days.

There are several types of Leafy Greens that are commercially available and differ by color, texture, maturity and head size. Types of Leafy Greens that can be grown in high tunnels include; Asian greens - Hon Tsai Tai, Chinese kale, Komatsuna, Mibuna, Mizuna and Tatsoi, Arugula, Pac Choi, Corn Salad/Mache, Cress and Mustard Greens. Leafy green types range in maturity from 35 to 55 days for full size heads. Baby greens types are ready from seeding to harvest in 21 days. Cress will mature in 10 to 12 days from seeding. Cooler air temperatures, below 32°F will slow growth of leafy green plants and increase time to maturity 10 to 15 days.

Environmental Requirements for Seeding Lettuce

Lettuce types are a hardy, cool season crop that can be grown in high tunnels 12 months of the year. Optimum growth occurs at temperatures between 60°F to 65°F. Seeds will germinate at soil temperatures as low as 40°F, but germinate very poorly at soil temperatures above 75°F. Successful and vigorous lettuce seed germination requires a firm seedbed and continuous soil moisture for germination.

Environmental Requirements for Lettuce Transplants

Seed lettuce in 128 or 200 cell trays with shallow placement in the soil (an optimum seeding depth of 0.25” deep) and cover with fine vermiculite. If temperature in the greenhouse or high tunnel exceeds 75°F during the day, place a shade cloth above trays to keep the soil cool and maintain active germination of the lettuce seeds. Prior to transplanting the lettuce transplants in the high tunnel, harden the transplants for 2 or 3 days by reducing water application to the transplants (but don’t let the soil cube dry out) or reduce the air temperature for 2 to 3 days before planting in high tunnel. Hardened transplants can survive air temperatures as low as 20°F in high tunnels after transplanting in the spring or fall.

Production of Lettuce in Summer

Many varieties of lettuce grown under high summer temperatures (85°F or higher) for 5 to 7 consecutive days are susceptible to bolting. Choose lettuce varieties when growing in the summer in high tunnels that are resistant to bolting. Plant spacing of seeded lettuce,

especially salad mixes is approximately 60 seeds/ft in a 4” to 6” wide band. Minimum spacing between bands will develop continuous plant canopy and help reduce weed seed germination. Spacing of transplants in raised beds should be dense enough to reduce weed growth in beds. Recommended spacing for lettuce transplants is 6” to 8” between transplants in-the-row and 12” to 18” between rows.

Establishing Leafy Greens in High Tunnels

Sow seed, especially baby lettuce mixtures, from mid-May through late August. Vigorous seed germination and emergence is critical for maximum yields and quality. Use transplants for late winter and late fall production. Use of 128 or 200 cell trays will produce ideal transplants in 14 to 20 days.

Many producers in the Mid-Atlantic and Northeast regions are growing lettuce in their high tunnels either as a major crop or mixed in with other vegetable crops. The majority of high tunnel producers are growing lettuce in soil either on raised beds or as flat culture. Recently on the HIGHTUNNELS@LISTSERV.KSU.EDU, many growers have reported problems of gray mold on lettuce because of the cool, wet soil conditions. The organism causing the Gray Mold, *Botrytis cinerea*, can remain in the soil for many years.

In 2007, Dr. Bernie Kratky from the University of Hawaii was on sabbatical leave here at the Penn State Center for Plasticulture. One of Bernie’s objectives while here was the production of lettuce in a non-circulating hydroponic system. The two tanks for the hydroponic system were constructed in the high tunnel and lined with 6 mil greenhouse-grade plastic. Each tank was 4’ x 24’ and 5" deep. When filled with water, each tank held 300 gallons of water. Blue, Styrofoam insulation board floated on top of the water. Holes were cut into the insulation board such that lettuce plants were spaced 8" x 12" – each tank then grow 144 lettuce plants. Plastic net pots were filled with the lettuce transplants grown in soilless media and then placed into the holes cut into the Styrofoam board. Fertilizer was added to the water before the lettuce plants were placed into the Styrofoam boards and no additional water or fertilizer was added to the crop.

In 2007, Dr. Kratky grew 4 lettuce crops that required 28 to 39 days from transplanting to harvest. Bibb, romaine and leafy lettuce types were grown successfully in this hydroponic system without any disease problems and a minor insect problem – grasshoppers. At the High Tunnel Research and Education Center at Rock Springs, there must have been 100 grasshoppers per square yard at the peak of their population in 2007, but screening the sides of the tunnel moderated the problem. This large grasshopper population ate everything from lettuce to cucumber and broccoli transplants. When harvested, the lettuce heads averaged about 0.5 pounds in weight and were of excellent quality. There had been no incidence of diseases on the lettuce plants on any of the four plantings in 2007.

2010 *Commercial Vegetable Production Recommendations* Guide for PA Now On-Line

Elsa Sánchez, Penn State Horticulture

The 2010 edition of the *Commercial Vegetable Production Recommendations* guide for Pennsylvania has just been made available and can be found through several links. The entire publication can be purchased as a hard copy or download for free at http://pubs.cas.psu.edu/PubTitle.asp?varTitle=Commercial+vegetable+production+recommen. The entire guide can also be found at http://pubs.cas.psu.edu/FreePubs/pdfs/agrs028.pdf and individual sections can be downloaded at http://horticulture.psu.edu/node/465.

Upcoming Meetings

If you have a meeting you would like to announce, please send the meeting title, date, location and contact information to esanchez@psu.edu.

Local

- February or March, 2010. **Plant Disease Workshop**, Potter County, PA. For more information contact Bill Waltman at (814) 274-8540 or wjw15@psu.edu.

- February 8, 2010. **Crops Conference**, Krisland Camp, PA. For more information contact Tom Ford at (814) 940-5989 or tgf2@psu.edu or Tom Butzler at (570) 726-0022 or tmb124@psu.edu.

- March 4, 2010. **Southeast Pennsylvania Vegetable Day,** Neshaminy Manor Center Doyleston, PA. For more information contact Scott Guiser at (215) 345-3283 or sxg6@psu.edu.

- March 4, 2010. **Southeast Pennsylvania Potato Day,** Schnecksville Grange, Schnecksville PA. For more information contact Bob Leiby at (610) 391-9840 or rel5@psu.edu.

- March 12, 2010. **Farm and Family Expo**, University of Pittsburg. For more information contact Tom Ford at (814) 940-5989 or tgf2@psu.edu or Tom Butzler at (570) 726-0022 or tmb124@psu.edu.

- March or April, 2010. **Vegetable Meeting**, Erie, PA. For more information contact Andy Muza at (814) 725-4601 or ajm4@psu.edu.

- March or April, 2010. **Small Fruit Meeting**, Erie, PA. For more information contact Andy Muza at (814) 725-4601 or ajm4@psu.edu.

- April 10, 2010. **Organic Vegetable Day**, Vera Cruz, PA. For more information contact Tianna Dupont at (610) 746-1970 or tdupont@psu.edu.

- May 8, 2010. **Organic Vegetable Day**, Vera Cruz, PA. For more information contact Tianna Dupont at (610) 746-1970 or tdupont@psu.edu.

- June 12, 2010. **Organic Vegetable Day**, Vera Cruz, PA. For more information contact Tianna Dupont at (610) 746-1970 or tdupont@psu.edu.

- July, 2010 (day TBA). **Vegetable and Fruit Day**, Oxford Auction, PA. For more information contact Cheryl Bjornson at (610) 696-3500 or cab46@psu.edu.

- July 10, 2010. **Organic Vegetable Day**, Vera Cruz, PA. For more information contact Tianna Dupont at (610) 746-1970 or tdupont@psu.edu.

- August 14, 2010. **Organic Vegetable Day**, Vera Cruz, PA. For more information contact Tianna Dupont at (610) 746-1970 or tdupont@psu.edu.

- November 16, 2010. **Western Pennsylvania Vegetable & Berry Seminar**, Butler, PA. For more information contact Eric Oesterling at (724) 837-1402 or reo1@psu.edu, Lee Young at (724) 228-6881 or ljs32@psu.edu or Bob Pollock at (724) 465-3880 or rcp3@psu.edu.

Regional

- February 2-4, 2010. **Mid-Atlantic Fruit and Vegetable Convention**, Hershey Lodge, Hershey, PA. For more information contact Bill Troxell at (717) 694-3596 or pvga@pvga.org or visit www.mafvc.org.

- February 5-12. **2010 North American Farmers' Direct Marketing Convention**, Lancaster, PA. For more information call (413) 529-0386 or visit www.nafdma.com/Pennsylvania.

- February 4-6, 2010. **Pennsylvania Association for Sustainable Agriculture (PASA) 19th Annual Farming for the Future Conference**. Penn Stater Conference Center, State College, PA. For more information visit www.pasafarming.org.

- March 9-10, 2010. **Greenhouse Tomato Short Course**, Eagle Ridge Conference Center, Raymond, MI. For more information contact Rick Snyder at RickS@ra.msstate.edu or visit http://greenhousetomatoesc.com.

National

- August 2-5, 2010. **Annual Meeting American Society for Horticultural Science**, Palm Desert, CA. For more information visit www.ashs.org.

International

- February 16-19, 2010. **Living Plants, Liveable Communities: Exploring Sustainable Horticulture for the 21st Century symposium**, Canadian Institute for Sustainable Biodiversity at the Royal Botanical Gardens. Register now at http://www.rbg.ca/cisb/2010symp.

- February 24-26, 2010. **North American Raspberry and Blackberry Association (NARBA) Conference.** Registration form and brochure are now posted at http://www.raspberryblackberry.com/Webdocs/webregistrationcolor.pdf.

To join our distribution list, send an e-mail to: Gazette-L-subscribe-request@lists.psu.edu.

No subject or message text is required. The system picks up the name and address from the e-mail headers. To delete yourself from the list send an e-mail to: Gazette-L-unscribe-request@lists.psu.edu. Again, no subject or message text is required.

The newsletter is also posted within three days on the Department of Horticulture Vegetable program website at: http://horticulture.psu.edu/cms/vegcrops.

Where trade names appear, no discrimination is intended, and no endorsement by Penn State Cooperative Extension is implied.

Penn State is committed to affirmative action, equal opportunity, and the diversity of its workforce.