

ARS Report to the NCR-101 Committee on Controlled Environment Technology and Use
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A. Growth Facilities Planned or Installed: Infiltration testing of the APHIS-permitted Containment Greenhouse Facility in Range 1 was successfully completed in the fall of 2004. Sterilization equipment in this facility is being evaluated; initial tests indicate that use of conventional steam sterilization for 30 minutes at 250⁰F in such facilities may not be adequate for killing spores of heat resistant organisms such as bean rust. Additional tests are planned on bean rust and other organisms to determine the efficacy of increasing the sterilization times to kill such spores. A ground-breaking ceremony was held on January 24, 2005 for rebuilding of the Plant Sciences Institute greenhouses – a complex that will house the exotic citrus disease research and serve as a support facility for the newly completed containment greenhouse facility. The ground breaking ceremony was attended by Congressman Steny Hoyer, 5th District, Maryland, Deputy Under Secretary, Research, Education and Economics Rodney Brown, ARS Administrator Edward Knipping and other dignitaries. Each of these greenhouses will be 100' long x 37' wide. Several temporary plastic greenhouses have also been erected during the past four years to replace the glass greenhouses destroyed by tornado damage on September 24, 2001. The Controlled Environment Facility (CEF) at BARC is 84% occupied. The Phytonutrients Lab (BHNRC) has installed 2 new EGC step-in M-28 growth chambers in the basement of B-308 to be used for labeling of plants for studies of nutrient bioavailability and metabolism in humans and to investigate control of accumulation of phenolic compounds in green, leafy vegetables. Plans are to acquire a third chamber this year with room for an eventual 4th chamber. Steve Britz indicates that they hope to install a xenon long arc lamp for solar simulation studies related to the investigation of phenolic compounds.

B. Other Facilities Planned or Installed: The new Beltsville Human Nutrition Research Center (BHNRC) facilities at BARC-East [Phase I (Bldg. 307B) and Phase II (Bldg. 307C)] have been completed and are fully operational. The design of the Phase III BHNRC renovation of Building 307 was completed in 2004 but the project is on hold since there is no funding anticipated in either the FY 2005 or FY 2006 budgets for construction. Phase III construction is expected to cost ca. \$25 million. ARS expects to award a contract for the Poultry Production Hatchery Barns (ca. \$4 million) in March 2005. Construction will begin as soon as soil samples are taken and environmental assessments are made. Plans for an Insect Quarantine Research facility have been deferred. The bulk of modernization funds for ARS in the President's budget for FY 2006 has been earmarked for modernizing facilities at the National Centers for Animal Health in Ames, IA. During the past two years, the National Agricultural Library has made a number of renovations. With funding from Homeland Security, they replaced and upgraded all of the security systems. They installed a sprinkler system on the 2nd, 3rd and 4th floors and replaced the ceilings and lights. During FY 2005, they began extensive brick repairs to install weep holes and expansion joints and repoint the bricks of the entire facade; weep holes and expansion joints were lacking in the original construction. Also, they plan to replace the failing chiller plant in FY 2005. In FY 2006, NAL hopes to complete brick repairs and replace single pane windows with double pane windows on the 3rd to the 13th floors, contingent on Congressional funding. Plans are to move the NAL Special Collection to the 5th floor once shelves are installed and it is certified as a National Archives facility.

C. Instruments and Sensors: During the past year, sensors were installed in the high tunnels to monitor soil moisture, air temperature, relative humidity, photosynthetically active radiation (PAR), total radiation, and ambient CO₂ using HOBO sensors obtained from Onset Computer Corp. (Bourne, MA). BARC continued to participate in the USDA UV-B Monitoring Program. A description of this program may be obtained at: <http://uvb.nrel.colostate.edu>. This monitoring program is managed by the Natural Resource Ecology Laboratory of Colorado State University (CSU). A suite of instruments has been located on the South Farm since 1998 to measure UV radiation and atmospheric optical properties. CSU researchers will be making synthetic spectra available on their web site for any of the locations having shadow band radiometers. The data for the CSU instruments are available on-line within 1 day of measurement. Steve Britz and Roman Mirecki, Phytonutrients Lab. are assisting in the operation of the facility.

D. Unique Plant Responses: A number of tomato plants in the high tunnels developed white mold at the base of the stem and subsequent stalk rot during the Spring experiment and had to be discarded. This disease is caused by a soil pathogen, *Sclerotinia sclerotiorum* (Lib.) de Bary.

E. Research Grants/Cooperative/Interdisciplinary Projects: During the past year, several of our papers on eastern gamagrass were published in *Acta Horticulturae* and in the Proceedings of the Third Eastern Native Grass Symposium. In 2004, we initiated work on our new CRIS Project, entitled "Management of Cover Crops for Enhancement of High Value Cropping Systems. One objective was to determine the feasibility of using high tunnels to obtain two crops of tomatoes by extending the growing season by 3-4 weeks in the spring and 3-4 weeks in the fall. Work was done in collaboration with a number of laboratories. Seedlings were transplanted at weekly intervals for 4 weeks in both the spring and the summer/ fall seasons. The high tunnels were covered with either a UV-transmitting plastic film (Tyco Tufflite 4) or a UV-blocking plastic film (AT Plastics Dura-Lite Super 4) to assess the possible benefit of blocking wavelengths known to be important in disease and insect regulation. Compost amendments were used for soil improvement and disease control. Several disease and management challenges were encountered during the first year. The spring crop had to be terminated prematurely because of poor drainage and stalk rot making it necessary to relocate the tunnels to an uninfested site with better drainage for the summer/fall crop. The summer/fall crop yielded high numbers of marketable quality fruits well beyond the Oct. 15 average killing frost date. The results suggest that with improved management there is a considerable potential for profitable extended-season production of organic tomatoes in this region. These findings should be of interest to high tunnel farmers and researchers interested in protected cultivation of high value crops. In July, 2004, Skip Kauffman (Accokeek Foundation), John Teasdale, Mark Davis (SASL), Bryan Butler (MCE), Jim Hanson (Univ. of Maryland), and I were awarded a SARE grant on "Season Extension and Cultivar valuations for Increasing Farmer Profitability Using High Tunnels in the Baltimore/Washington Metropolitan Marketing Area." We are cooperating with five high tunnel growers on this project. Skip is the PI on this grant. SASL is continuing cooperative research with Rodale Institute and Penn State University on improving weed management for organic farming, BARC is cooperating with NASA and the USDA UV-B Monitoring Program (funded by CSREES and operated out of CSU and SUNY, Albany) as indicated in C.

F. Committees and Sub-Committees Served: In July 2004, I was appointed Associate Editor, Photochemistry and Photobiology. I also served on the editorial board of *Environmental and Experimental Botany* during the past year.

G. Workshops/Colloquia/Symposia: On 13 July 2004, I organized a Symposium on UV Effects on Terrestrial Ecosystems at the American Society for Photobiology (ASP) Meeting in Seattle, WA at the invitation of Donat Hader. Partial funding to help defray costs for the two ASP Symposia was provided by ASP and the Beltsville Area Director's Office. Selected papers presented at the symposium and several invited manuscripts will be published in a Symposium-in-Print in *Photochemistry and Photobiology*. Dr. Linda Chalker-Scott and I will be guest editors of this Symposium-in-Print. Papers presented at the International Horticultural Congress in Toronto in August 2002 and at the 3rd Eastern Native Grass Symposium in Oct 2002 at the Univ. of North Carolina, in Chapel Hill, NC have been published (See J).

H. Personnel: Dr. James Anderson, formerly Associate Director, Plant Science Institute, retired on Jan. 31, 2005. Major personnel changes are underway in the Facilities Management and Organization Division (FMOD) as a result of competitive outsourcing (A-76) efforts. The agency's Most Efficient Organization (MEO) proposals were awarded both the "facilities services" and the "research support services" functions. These organizations will be effective May 15, 2005. Bob Mach in the Modernization Office is retiring May 15, 2005 and the office will be closed. Fifty-three positions in FMOD will be abolished at BARC; 39 individuals have accepted an OMB-authorized buyout. The BHNRC and the Controlled Environment Facility will no longer have an engineering technician; Jon Wright and Al Wycoski will be offered other positions and Gary Fisher, Dave Grigonis and several engineering technicians from NAL will be leaving. The Alternate Crops and Systems Laboratory was divided into the Crop Systems and Global Change Lab (CSGCL) and the Sustainable Perennial Crops Lab. (SPCL). Autar Mattoo, a Plant Physiologist and Salma Malik, an Office Automation Assistant joined SASL during the past two months. Charles Foy and Richard Thimijan continue to serve as SASL volunteers.

I. Internet Entries/Access: Information on ARS research programs in the 35 labs and 4 institutes at BARC may be accessed at: <http://www.ba.ars.usda.gov/>. Information on SASL may be accessed at: <http://www.ba.ars.usda.gov/sasl/>. Information on BHNRC may be accessed at: <http://www.barc.usda.gov/bhnrc/>. Information on the Produce Quality and Safety Lab (PQSL) may be accessed at: <http://www.barc.usda.gov/psi/pqsl/>. Images of the construction of the CEF may be accessed at: http://www.ba.ars.usda.gov/sasl/krizek/cef_const.html.

J. Selected List of Recent Publications: 2003-2005

- Abdul-Baki, A.A., H. Bryan, W. Klassen, L.W. Carrera, W.C. Li and Q. Wang. 2004. Low production cost alternative systems are the avenue for future sustainability of vegetable growers in the U.S. *Acta Hort.* 638:419-423.
- Allende, A., Y. Luo., J. McEvoy, F. Artes and C.Y. Wang. 2004. Microbial and quality changes in minimally processed baby spinach leaves stored under super atmospheric oxygen and modified atmosphere conditions. *Postharvest Biol. Technol.* 33:51-59.
- Ayala-Zavala, J.F., S.Y., C.Y. Wang, and G.A. Gonzalez-Aguilar. 2004. Effect of storage temperatures on antioxidant capacity and aroma compounds in strawberry fruit. *Food Sci. & Tech.* 37: 687-695.
- Baker, J.T, S.-H. Kim, D.C. Gitz, D. Timlin and V.R. Reddy. 2004. Estimating carbon dioxide leakage rates in controlled-environment chambers using nitrous oxide. *Environ. Expt. Bot.* 51:103-110.
- Cassol, T. and A.K. Mattoo. 2003. Do polyamines and ethylene interact to regulate plant growth, development and senescence? In: *Molecular Insights in Plant Biology*, (P. Nath, A. Mattoo, S.R. Ranade, and J.H. Weil, eds.), Science Publishers, Inc., Enfield, USA. pp. 121-132.
- Cheng, X., Y.R.Chen, Y.Tao, C.Y. Wang, M.S. Kim and A.M. Lefcourt. 2004. A novel integrated PCA and FLD method on hyperspectral image feature extraction for cucumber chilling damage inspection. *Trans. Am.. Soc. Agr. Eng.* 47:1313-1320.
- Fung, R., C. Wang, D. Smith, K. Gross and M. Tian. 2004. MeSA and MeJA increase steady-state transcript levels of alternative oxidase and resistance against chilling injury in sweet peppers (*Capsicum annuum L.*). *Plant Sci.* 166:711-719.
- Gitz, D.C., J.C. Ritchie, J.T Baker, D.T. Krizek and V.R. Reddy. 2004. Temperature and CO₂ effects on eastern gamagrass: Photosynthetic performance. In: J.C. Burns and J.L. Randall, (eds.), *Proceedings of the Third Eastern Native Grass Symposium*, Oct. 1-3, 2002, Chapel Hill, NC, Omnipress, Madison, WI. pp. 203-210.
- Krizek, D.T. 2004. Invited Review. Influence of PAR and UV-A in determining plant sensitivity and photomorphogenic responses to UV-B radiation. *Photochem. Photobiol.* 79(4):307-315.
- Krizek, D. T. and W. Gao. 2004. Symposium-in-Print. Introduction. *Ultraviolet Radiation and Terrestrial Ecosystems.* *Photochem. Photobiol.* 79(5):379-381.
- Krizek, D.T. and R.M. Mirecki. 2004. Evidence for phytotoxic effects of cellulose acetate in UV exclusion studies. *Environ. Expt. Bot.* 51:33-43.
- Krizek, D.T., D.C. Gitz, J.C. Ritchie and V.R. Reddy. 2004. Biomass accumulation and partitioning of eastern gamagrass grown under different temperature and CO₂ levels. *Acta Hort.* 638:293-299.
- Krizek, D.T., M.A. Solis, P.A. Touhey, J.C. Ritchie and P.D. Millner. 2004. Rediscovery of the southern cornstalk borer: a potentially serious pest of eastern gamagrass and strategies for mitigation. In: J.C. Burns and J.L. Randall (eds.), *Proceedings of the Third Eastern Native Grass Symposium*, Oct. 1-3, 2002, Chapel Hill, NC, Omni Press, Madison, WI. pp. 277-283.
- Kumar, V., D.J. Mills, J.D. Anderson and A.K. Mattoo. 2004. Delayed senescence and disease tolerance of tomato plants cultivated in cover crop mulch correlates with accumulation of specific gene products. *Acta Hort.* 638:497-502.
- Kumar, V., D.J. Mills, J.D. Anderson and A.K. Mattoo. 2004. An alternative agriculture system is defined by a distinct

expression profile of select gene transcripts and proteins. *Proc. Natl. Acad. Sci. USA.* 101:10535-10540.

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Lu, Y.-C., J.R. Teasdale and W.-Y. Huang. 2003. An economic and environmental tradeoff analysis of sustainable agricultural cropping systems. *J. Sustain. Agric.* 22(3):25-41.

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Teasdale, J.R., A.A. Abdul-Baki, D.J. Mills and K.W. Thorpe. 2004. Enhanced pest management with cover crop mulches. *Acta Hort.* 638:135-140.

Wang, C.Y. 2003. Maintaining postharvest quality of raspberries with natural volatile compounds. *Intl. J. Food Sci. Technol.* 38:869-876.

Wang, C.Y. 2004. Effect of postharvest techniques on health and nutritional values of fruits and vegetables. *Proc. Intl. Conf. Plant Health Management.* pp. 173-181.

Wang, C.Y. and J.G. Buta. 2003. Maintaining quality of fresh-cut kiwifruit with volatile compounds. *Postharvest Biol. Technol.* 28:181-186.

Wang, S.Y. 2003. Antioxidant capacity of berry crops, culinary herbs and medicinal herbs. *Acta Hort.* 620:461-473.

Wang, S.Y. and H.S. Lin. 2003. Compost as a soil supplement increases the level of antioxidant compounds and oxygen radical absorbing capacity in strawberry. *J. Agr. Food Chem.* 51:6844-6850.

Wang, S.Y., W. Zheng and J.L. Maas. 2003. High plant growth temperatures increase antioxidant capacities in strawberry fruit. *Acta Hort.* 626:57-63.

Wang, S.Y. and W. Zheng. 2005. Preharvest application of methyl jasmonate increases fruit quality and antioxidant capacity in raspberries. *Intl. J. Food & Technology* 40:187-195.

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