ARS Report to NCR-101 Committee on Controlled Environment Technology and Use
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Donald T. Krizek, USDA Sustainable Agricultural Systems Laboratory, ARS, ANRI, Bldg. 001, BARC-West, Beltsville, MD 20705-2350, USA; Tel. 301-504-5324; Fax: 301-504-6626; e-mail: dkrizek@asrr.arsusda.gov.

A. Tornado Damage: The Beltsville Agricultural Research Center (BARC) sustained over 21 million dollars in tornado damage on September 24, 2001. Fortunately, there were no injuries of USDA personnel, although two students were killed at the University of Maryland during the storm. Many of the greenhouses were severely damaged and windows were blown out of several buildings at BARC-WEST including the National Agricultural Library and Building 1. Shingles were blown off the roofs of many buildings and have had to be replaced. Numerous glass panes have been replaced in the new Range 2 greenhouses (including over 40 panes of low-iron glass in GH 5/Section 11). Many of the greenhouses in Range 1 and Range 3 sustained structural damage beyond repair and will have to be torn down. Numerous trees were blown over and had to be cut down and removed. Extensive landscaping is underway to replace some of the plantings that were lost in the storm.

B. New Facilities Planned or Installed: Several construction projects are underway at BARC. Phase I and Phase II of the new Beltsville Human Nutrition Research Center (BHNRC) Facilities at BARC-EAST (Bldg. 307) are currently under construction and are 35-40% completed; final completion is expected August 2003. The Animal Biotechnology Facility is 90% completed; final completion is expected June 2002. The new Feed Center is over 99% complete. Good progress is being made on construction of the Level III Biocontainment Facility; completion is expected 31 August 2002. The Biocontainment Facility will contain 5000 sq ft (including ca. 2500 sq. ft. under glass). The greenhouse covering of this facility will consist of two 1/4 inch panes of glass mounted in an aluminum framework with a _ inch space between the layers of glass; double beads of caulking will be used to seal the glass. Construction of the APHIS Level III Containment Greenhouse began nearly six years ago but a number of technical issues remain. Renovations of Bldg. 004 are over 99% complete; the building was formally dedicated in April 2002 but a few technical issues involving balancing the ventilation system remain. A proposal has been made to construct three greenhouses in Range 1 adjacent to the Biocontainment Greenhouse at a cost of ca. $1 million each after the damaged greenhouses are removed. One facility being considered is an Insect Quarantine Research Greenhouse; another is a Citrus Quarantine Greenhouse. As a cost-saving effort, three "arched"greenhouses with double layered plastic sleeves mounted over aluminum framing were set up for seasonal use by BARC scientists requiring only minimal environmental control. The Controlled Environment Facility (CEF) at BARC was completed in 1998 and is now over 80% occupied with about 70% of the growth chambers (GC) in use. Primary users include the Alternate Crops and Systems Lab (ACSL, 19 GC), the Floral and Nursery Plants Research Unit (7 GC), the Phytonutrients Lab (3) and the Fruit Lab (8 GC). Other users include the Produce Quality and Safety Lab (1 GC), the Environmental Quality Lab (EQL,4 GC), the Soybean Genomics & Improvement Lab (2 GC), and the Sustainable Agricultural Systems Lab (SASL, 1 GC).

C. Instruments and Sensors: Plans are underway in the Phytonutrients Lab (S.J. Britz, R.M. Mirecki, W.A. Bailey) to construct a ^{13}C plant growth chamber to study metabolism of carotenoids in humans using carrots as the source of food. The new minirhizotron camera system (BTC-2) and image capture system (BTC-1) was successfully tested (J.C. Ritchie, D. Gitz, J. Ephrath, D.T. Krizek, V.R. Reddy) in the SPAR chambers at BARC (Bartz Technology Corp., Santa Barbara, CA). The minirhizotron with video camera was used to image root growth of eastern gamagrass and cotton kept under ambient and elevated CO_2 in sunlit growth chambers (maintained by ACSL) in a joint study involving ACSL, Hydrology & Remote Sensing (HRSL), and SASL to determine CO_2 x temperature interactions in eastern gamagrass and CO_2 x water stress interactions in cotton. A preliminary report of this work was given (J.C. Ritchie et al.) at the Association of Southeastern Biologists Meeting and additional reports will be given (D.T. Krizek et al., D. Gitz, et al.) at the International Horticultural Congress in Toronto, Canada and at the Third Eastern Native Grass Symposium in Chapel Hill, NC. BARC continued to participate in the USDA UV-B Monitoring Program. A description of this program (overview, climatological network, research activities, instrumentation, intercomparisons, project bibliography, staff directory, and related resources) 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 state-of-the art instruments (costing ca. $1 million) has been located on the South Farm since 1998 adjacent to (or within proximity of) the Air Pollution facility to measure UV radiation and atmospheric optical properties. These instruments are maintained by personnel from CSU and State University of New York (SUNY) at Albany. The data are available on-line from all sites within 1 day of measurement. There are 27 instruments in the network, including several sensors from Yankee Environmental Systems (UV-A pyranometer, UV B-1 pyranometer, UV Multi Filter Rotating Shadow Band

Radiometer (UV-MFRSR), and a VIS MFRSR. A state-of-the-art UV scanning radiometer has also been installed (see 1999 report for details of these instruments). BARC staff (Steve Britz and Roman Mirecki, Phytonutrients Lab) are assisting in the operation of the facility and will have access to the data as part of the BARC-Univ. of Maryland (UMD) College Park program to study the effects of UV radiation on plants.

D. Unique Plant Responses: Seed dormancy continues to be a major problem in successful establishment of eastern gamagrass plantings because of the morphological barrier imposed by the cupulate fruit case. Weed competition during early seedling growth is another obstacle to stand establishment. Mysterious dieback of several stands of eastern gamagrass on the North Farm were found to be caused by the southern corn stalk borer, a pest that has not been reported in the DC area for over 100 years.

E. Research Grants/Cooperative/Interdisciplinary Projects: I continue to serve as Principal Investigator on an USDA Competitive Grant entitled: "Eastern gamagrass for forage, soil improvement, and buffer strips". Cooperative studies are being conducted on the grant and on other projects in collaboration with researchers from several ARS labs at Beltsville (HRSL, Jerry Ritchie; EQL, Ali Sadeghi; Animal Manure & By-Products Lab, Jim Reeves; SASL, Aref Abdul Baki, Ben Coffman, John Teasdale; ACSL, Jeff Baker, Dennis Gitz, V.R. Reddy; Dennis Timlin; the Agricultural Marketing Service (AMS, Susan Maxon), the Natural Resources Conservation Service (NRCS, John Davis, Kathy Davis), Maryland Cooperative Extension (Jim Hanson, Les Vough), and the University of Maryland, Department of Natural Resource Sciences and Landscape Architecture (Ray Weil, Rachel Gilker, Stacey Williams). 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: I continue to serve on the Editorial Boards of Environmental and Experimental Botany, and Biotronics.

G. Workshops/Colloquia/Symposia: Several abstracts have been submitted for oral and/or poster presentations at the Third Eastern Native Grass Symposium to be held 1-3 Oct 2002 at the Univ. of North Carolina, in Chapel Hill, NC. Proceedings of the symposium will be edited by Johnny Randall, Asst. Director, North Carolina Botanical Garden and Bob Glennon, Natural Resource Planner, U.S. Fish and Wildlife Service, Edenton, NC. I attended the Joint UK-CEUG & NCR-101 International Conference on Controlled Environments in Norwich, U.K. 9-14 Sept 2001 and plan to attend the International Horticultural Congress in Toronto, Canada 11-17 Aug 2002.

H. Personnel: Dr. Wanda Collins, former President, ASHS, was appointed Director, Plant Sciences Institute. Good progress is being made on implementing the moves of personnel following the reorganization of BARC in Nov. 2000. A description of the new labs may be obtained at the following home pages: www.barc.usda.gov, www.ba.ars.usda.gov/reorg.html, and www.anri.barc.usda.gov. Steve Britz, Charles Caldwell, Diane Kramer, and Roman Mirecki, have moved to the Phytonutrients Lab; Mike Robinson, Randy Rowland and Walter Stracke were reassigned from SASL to EQL. Charles Foy is continuing as collaborator on the gamagrass project. Dr.Ephrath returned to Israel on April 4. Dave Clark has assumed responsibility for maintaining plants in the SASL and has been giving me a hand since Oct 2001. I will be moving my lab and office from Bldg. 048 to Bldg. 001 shortly.

I. Recent Publications: A selected list of publications is attached (See **K**).

J. Internet Entries/Access: Information on research programs at BARC may be accessed at the following home page: www.barc.usda.gov. Information on SASL may be accessed at: www.barc.usda.gov/anri/sasl/sasl.html and information on ACSL may be accessed at: http://wizard.arsusda.gov/acsl/acslhome.html. Images taken during the construction of the CEF, Bldg. 004, and the Human Nutrition Research Center facilities may be examined by opening the home page: www.barc.usda.gov/fmod/modern and then selecting "Construction Site Picture Gallery".

K. Selected List of Recent Publications:

Abdul-Baki, A.A., H.H. Bryan, G.M. Zinati, W. Klassen, M. Codallo, and N. Heckert. 2001. Biomass yield and flower production in sunn hemp: Effect of cutting the main stem. J. Veg. Crop Prod. 7:83-104.

Baker, J.T., D.I. Leskovar, V.R. Reddy, and F.J. Dainello. 2001. A simple phenological model of muskmelon development. Ann. Bot. 87:615-621.

Baker, J.T. and V.R. Reddy. 2001. Temperature effects on phenological development and yield of muskmelon. Ann. Bot. 87: 605-613.

Britz, S.J. and J.M. Robinson. 2001. Chronic ozone exposure and photosynthate partitioning into starch in soybean leaves. Intl. J. Plant Sci. 162:15-26.

Bunce, J.A. 2001. Are annual plants adapted to the current atmospheric concentration of carbon dioxide? Internat. J.Plant Sci. 162:1261-1266.

Bunce, J.A. 2001. Direct and acclimatory responses of stomatal conductance to elevated carbon dioxide in four herbaceous crop species in the field. Global Change Biol. 7:323-331.

Bunce, J.A. 2001. Effects of prolonged darkness on the sensitivity of leaf respiration to carbon dioxide concentration in C_3 and C_4 species. Ann. Bot. 87:463-468.

Bunce, J.A. 2001. The response of soybean seedling growth to carbon dioxide concentration at night in different thermal regimes. Biotronics 30:15-26.

Buyer, J.S., D.P. Roberts, P. Millner, and E. Russek-Cohen. 2001. Analysis of fungal communities by sole carbon source utilization profiles. J. Microbiol. Methods. 45:53-60.

Caldwell, C.R. 2001. Effect of elevated manganese on the ultraviolet-and blue-light absorbing compounds of cucumber cotyledon and leaf tissues. J. Plant Nutr. 24:283-296.

Caldwell, C.R. 2001. Effect of elevated iron on ultraviolet-absorbing compounds of cucumber cotyledon and leaf tissues. J. Plant Nutr. 24:297-312.

Erkan, M., C.Y. Wang, and D.T. Krizek. 2001. UV-C irradiation reduces microbial populations and deterioration in *Cucurbita pepo* fruit tissue. Env. Exp. Bot. 45:1-9.

Gagliardi, J.V., J.S. Buyer, J.S. Angle, and E. Russek-Cohen. 2001. Structural and functional analysis of whole-soil microbial communities for risk and efficacy testing following microbial inoculation of wheat roots in diverse soils. Soil Biol. Biochem. 33:25-40.

Gilker, R.E., R.R. Weil, D.T. Krizek, and B. Momen. 2002. Eastern gamagrass root penetration in adverse subsoil conditions. Soil Sci. Soc. Am. J. 66(3):931-938.

González-Aguilar, G.A., C.Y. Wang, J.G. Buta, and D.T. Krizek. 2001. Use of UV-C irradiation to prevent decay and maintain postharvest quality of ripe 'Tommy Atkins' mangoes. Intl. J. Food Sci. Tech. 36:1-7.

Graham, J.L. 2001. Eastern gamagrass for forage, soil improvement, and buffer strips. Tech. Update #5. Mid-Atlantic IRT, Dover, DE. 9p.

Krizek, D.T., E.W. Middleton, R.K. Sandhu, and M.S. Kim. 2001. Evaluating UV-B effects and EDU protection in cucumber leaves using fluorescence images and fluorescence emission spectra. J. Plant Physiol. 158:41-53.
Krizek, D.T., J.C. Ritchie, A.M. Sadeghi, C.D. Foy, E.G. Rhoden, J.R. Davis, and M.J. Camp. 2002. A four-year study of biomass production of eastern gamagrass grown on an acid compact soil. Commun. Soil Sci. & Plant Anal. In Press.

Krizek, D.T., P.H. Terry, A. Upadhyaya, C.R. Caldwell, and R.M. Mirecki. 2001. Changes in abscisic acid,

stomatal conductance, and antioxidants during low temperature preconditioning against SO_2 injury in contrasting cultivars of coleus. Biotronics 30:1-14.

Matthews, B.F., T.E. Devine, J.M. Weisemann, H.S. Beard, K.S. Lewers, M.H. MacDonald, Y.B. Park, R. Maiti, J.J. Lin, J. Kuo, M.J. Pedroni, and J.A. Saunders. 2001. Incorporation of sequenced cDNA and genomic markers into the soybean genetic map. Crop Sci. 41(2):516-521.

Norman, H.A., D.T. Krizek, and R.M. Mirecki. 2001. Changes in membrane lipid and free fatty acid composition during low temperature preconditioning against SO_2 injury in coleus. Phytochemistry 58:263-268.

Pachepsky, Y., D. Benson, and D.J. Timlin. 2001. Transport of water and solutes in soil as a porous fractal media. In: H.M. Selim and D.L. Sparks (eds.) Physical and Chemical Processes of Water and Solute Transport/Retention in Soil. ASA Spec. Pub. 56. ASA, CSSA, and SSSA, Madison, WI. p. 51-75.

Perrygo, C.L., A. Shirmohammadi, J.C. Ritchie, and W.J. Rawls. 2001. Effect of eastern gamagrass on infiltration rate and soil physical and hydraulic properties. In: D. Bosch (ed.) Preferential Flow. American Society of Agricultural Engineers, St. Joseph, MI. p. 254-268.

Rillig, M.C., S.F. Wright, B.A. Kimball, P.J. Pinter, G.W. Wall, M.J. Ottman, and S.W. Leavitt. 2001. Elevated carbon dioxide and irrigation effects on water stable aggregates in a Sorghum field: a possible role for arbuscular mycorrhizal fungi. Global Change Biol. 7:333-337.

Rillig, M.C., S.F. Wright, K.A. Nichols, W.F. Schmidt and M.S. Torn. 2001. Large contribution of arbuscular mycorrhizal fungi to soil carbon pools in tropical forest soils. Plant and Soil. 233:167-177.

Robinson, J.M. and S.J. Britz. 2001. Ascorbate-dehydroascorbate level and redux status in leaflets of field-grown soybeans exposed to elevated ozone. Intl. J. Plant Sci. 162:119-125.

Sheaffer, C.C., J.H. Orf, T.E. Devine, and J.G. Jewett. 2001. Yield and quality of forage soybeans. Agron. J. 93(1):99-106.

Sicher, R.C. 2001. Responses of nitrogen metabolism in N-sufficient barley primary leaves to plant growth in elevated atmospheric carbon dioxide. Photosyn. Res. 68:193-201.

Sicher, R.C. and J.A. Bunce. 2001. Adjustments of net photosynthesis in *Solanum tuberosum* in response to reciprocal changes in ambient and elevated growth CO_2 partial pressures. Physiol. Plant. 112:55-61.

Sikora, L.J. and W.J. Rawls. 2001. *In-situ* respiration determination as a tool for classifying soils according to soil organic matter content. Commun. Soil Sci. Plant Anal. 31:2793-2801.

Ziska, L.H. 2001. Acclimation to growth temperature alters the temperature dependent stimulation of photosynthesis to elevated carbon dioxide in *Abutilon theophrasti*. Physiol. Plant. 111:322-328.

Ziska, L.H. 2001. Growth temperature can alter the temperature dependent stimulation of photosynthesis by elevated carbon dioxide in *Abutilon theophrasti*. Physiol. Plant. 111:322-328.

Ziska, L.H., J.A. Bunce, and F.A. Caulfield. 2001. Rising atmospheric carbon dioxide and seed yield of soybean genotypes. Crop Sci. 41:385-391.