ARS Report to NCR-101 Committee on Controlled Environment Technology and Use
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A. Reorganization: The Beltsville Area Office announced a major reorganization of the Beltsville Agricultural Research Center (BARC) on 17 October 2000 and officially implemented the changes on 19 November. As a result of the reorganization, there was a net decrease of five research management units (MU's) and the number of institutes/centers was reduced from five to four. The Natural Resources Institute was dissolved and the Livestock and Poultry Sciences Institute was renamed the Animal and Natural Resources Institute (ANRI). New MU's include: the Sustainable Agricultural Systems Laboratory (SASL, John Teasdale, Res. Leader), the Alternate Crops and Systems Laboratory (ACSL,V.R. Reddy, Res. Leader), the Hydrology and Remote Sensing Laboratory (HRSL, Walter Rawls, Res. Leader), the Environmental Quality Laboratory (EQL, Cathleen Hapeman, Res. Leader), and the Animal Waste Pathogen Laboratory (AWPL, Michael Perdue, Res. Leader). The Horticultural Crops Quality Laboratory was renamed the Produce Quality and Safety Laboratory (Ken Gross, Res. Leader) and the Nutrient Conservation and Metabolism Laboratory was renamed the Animal Manure & By-Products Laboratory (AMBL, Michael Byers, Res. Leader). Details of the reorganization and 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.

B. New Facilities Planned or Installed: Several construction projects are underway or are being considered for funding at the Beltsville Agricultural Research Center (BARC). These include new Beltsville Human Nutrition Research Center (BHNRC) Facilities (Phase I - $11.4M funded; Phase II - $11.4M funded; Phase III - $17.3M proposed for FY 2003), an Animal Biotechnology Facility ($3.0M), Poultry and Hatchery and Production Barns ($1.3M), a Level III Biocontainment Greenhouse ($4.2M), a new Feed Center ($3.3M), and an Insect Quarantine Research Greenhouse. The Biocontainment Facility is being built and will contain 5000 sq ft (including ca. 2500 sq. ft. under glass). Renovations will be completed on Bldg. 004 ($7.2M) by December 2001. The Controlled Environment Facility (CEF) ($5.1M) was completed and dedicated in 1998. The CEF is now over 80% occupied with about 70% of the growth chambers (GC) in use. Primary users include the Alternate Crops and Systems Laboratory (26 GC), the Floral and Nursery Plants Research Unit (5 GC), and the Fruit Laboratory (8 GC). Other users include the Produce Quality and Safety Laboratory (1 GC), the Environmental Quality Laboratory (2 GC) and the Soybean Genomics & Improvement Laboratory (3 GC).

C. Instruments and Sensors: Instruments acquired this year include a Chlorophyll Meter (Field Scout, Spectrum Technologies, Inc., Plainfield, IL), a Chlorophyll Fluorometer (Model OS-30 Opti-Sciences, Tyngsboro, MA), a digital camera (Nikon Coolpix 995, Torrance, CA), and a minirhizotron camera system (BTC-2) and image capture system (BTC-1) (Bartz Technology Corp., Santa Barbara, CA). The minirhizotron with video camera is being used to image root growth of eastern gamagrass and cotton kept under ambient and elevated CO_2 in sunlit growth chambers (maintained by the ACSL) in a joint study involving ACSL, HRSL, and SASL to determine CO_2 x temperature interactions in eastern gamagrass and CO_2 x water stress interactions in cotton. 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: A newly developed laboratory fluorescence imaging system was used in collaborative studies with scientists from USDA, NASA and Troy State University to obtain fluorescence images of freshly excised cucumber leaves following UV-B exposure. UV-B damage included a reduction in leaf size, a decrease in chlorophyll a and chlorophyll a/b ratio, and an increase in UV-B absorbing compounds (at 300 nm). The red/green ratio was lower for UV-B exposed plants and the UV/blue ratio was reduced by UV-B exposure and was inversely related to total photosynthetic pigment content. These findings support the validity of the imaging technique as a non-destructive tool for assessing UV-B damage in plants and suggest that the red/green ratio and the UV/blue ratio may be useful in detecting UV-B stress, a finding not previously reported.

E. Research Grants/Cooperative/Interdisciplinary Projects: Don Krizek is continuing 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 in collaboration with researchers from several ARS laboratories at Beltsville (Jerry Ritchie, HRSL; Ali Sadeghi, EQL; Jim Reeves, AMBL; Ben Coffman, SASL); the Agricultural Marketing Service (AMS, Susan Maxon), the Natural Resources Conservation Service (NRCS, 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). Ms. Gilker completed her Master's degree at UMD in May 2000. 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: Don Krizek continues to serve on the Editorial Boards of Environmental and Experimental Botany, and Biotronics.

G. Workshops/Colloquia/Symposia: The Proceedings of the Second Eastern Native Grass Symposium held 17 to 19 November 1999 in Baltimore, MD were published in May 2000. The publication was edited by Jerry Ritchie, John Dickerson, and Carole Ritchie and published by the Agricultural Research Service (ARS) and the Natural Resources Conservation Service (NRCS), Beltsville, MD.

H. Personnel: Steve Britz, Charles Caldwell, Diane Kramer, and Roman Mirecki, were assigned to the Phytonutrients Laboratory; Jim Bunce, Jim Saunders, Sue Mischke, Rich Sicher, Lew Ziska, Fran Caulfield , Bill Harris, Martha Tomecek, Bob Erdman, Shaun Faulkner, and Ernie Goins, were assigned to ACSL; and Don Krizek, Aref Abdul-Baki, Jeff Buyer, Michel Cavigelli, Ben Coffman, Mark Davis, Tom Devine, Yao-Chi Lu, John Lydon, Pat Millner, Mike Robinson, Sara Wright, Dave Clark, Ruth Mangum, Mickey McCloud, Carl Roeder,, Randy Rowland, and Walter Stracke were assigned to SASL. Charles Foy is continuing as collaborator on the gamagrass project. Don Krizek (SASL) and Jerry Ritchie (HRSL) are collaborating with V.R. Reddy (ACSL), Dennis Gitz (ACSL), Jeff Baker (ACSL), Dennis Timlin (ACSL) and Jonathan Ephrath (Israel) (ACSL) on the CO_2 studies in the SPAR chambers with assistance from Jackson Fisher and Bob Jones (ACSL).

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

J. Software and/or Video Tapes Developed:
Krupinsky, J.M., D.L. Tanaka, J.S. Fehmi, S.D. Merrill, J.R. Hendrickson, R.E. Ries, M.A. Liebig, S. Wright, and J.D. Hanson. 2001. A computer program to assist sunflower producers. Proc. 23rd Sunflower Research Workshop. p. 83-84.
USDA-NRCS, Mid-Atlantic Interdisciplinary Resource Team, Dover, DE. Eastern Gamagrass From the Past to the Future. 17:45 min. Videotape, 1999; Eastern Gamagrass: From Planting to Harvest. 18 min. Videotape. Contact Ms. Janet L. Graham, tel: 302-678-4178; e -mail: janet.graham@de.usda.gov for more information.

K. 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".

L. 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.

Allen, L.H. Jr., M.P. Brakke, J.T. Baker, and J.W. Jones. 2000. Gas exchange and biomass responses of young citrus trees to partial rooting-volume irrigation. Soil Crop Sci. Soc. Fla. Proc. 59:37-45.

Allen, L.H. Jr., A.J. Rowland-Bamford, J.T. Baker, K.J. Boote., and G. Bowes. 2000. Response of rice to ribulose-1,5-bisphosphate carboxylase/oxygenase activity to elevated CO_2 concentration and temperature. Soil Crop Sci. Soc. Fla. Proc. 59:46-56.

Baker, J.T., L.H. Allen Jr., K.J. Boote, and N.B. Pickering. 2000. Direct effects of atmospheric carbon dioxide concentration on whole canopy dark respiration of rice. Global Change Biol. 6(3):275-286.

Baker, J.T., L.H. Allen Jr., K.J. Boote, and N.B. Pickering. 2000. Whole canopy, respiratory responses of rice to daytime carbon dioxide enrichment, temperature and drought. The World Resource Review 12(1):171-198.

Baker, J.T., B.N. Dunlop, J.A. Hogan, K.E. Idso, H. Johnson, S.H. Wittwer. 2000. Impact of increasing global CO_2 concentrations on biological productivity: Panel 2. Second International Dixy Lee Ray Memorial Symposium, August 1999, Washington D.C. Technology. 7:257-266.

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. 2000. Acclimation of photosynthesis to temperature in eight cool and warm climate herbaceous C_3 species: temperature dependence of parameters of a biochemical photosynthesis model. Photosyn. Res. 63:59-67.

Bunce, J.A. 2000. Acclimation to temperature of the response of photosynthesis to increased carbon dioxide concentration in *Taraxacum officinale*. Photosyn. Res. 64:89-94.

Bunce, J.A. 2000. Contrasting effects of carbon dioxide and irradiance on the acclimation of photosynthesis in developing soybean leaves. Photosynthetica 38:83-89.

Bunce, J.A. 2000. Responses of stomatal conductance to light, humidity, and temperature in winter wheat and barley grown at three concentrations of carbon dioxide in the field. Global Change Biol. 6:371-382.

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. and L.H. Ziska. 2000. Crop ecosystem responses to climatic change: crop/weed interactions. In: K.R. Reddy and H.F. Hodges (eds.) Climate Change and Global Crop Productivity. CABI Press, Wallingford. p. 333-352.

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. 2000. A device for the semi-automatic determination of oxygen-radical absorbance capacity. Anal. Biochem. 287:226-233.

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.

Chernikova, T., J.M. Robinson, E.H. Lee, and C.L. Mulchi. 2000. Ozone tolerance and antioxidant enzyme activity in soybean cultivars. Photosynthesis Res. 64:15-26.

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.

Ferreyra, R.A., L.B. Pachepsky, D. Collino, and B. Acock. 2000. Modeling peanut leaf gas exchange for the calibration of crop models for different cultivars. Ecol. Modelling. 131:285-298.

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.

Ghannoum, O., S. von Caemmerer, L.H. Ziska, and J.P. Conroy. 2000. The growth response of C_4 plants to rising atmospheric CO_2 concentrations: A reassessment. Plant Cell and Environ. 23:931-942.

Gilker, R.E. 2000. Eastern gamagrass root penetration in adverse subsoil conditions. MS Thesis, University of Maryland. 65 p.

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. 2000. Eastern gamagrass for forage, soil improvement, and buffer strips. Tech. Update #4. Mid-Atlantic IRT, Dover, DE. 6 p.

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

Hall, A.E. and L.H. Ziska. 2000. Crop breeding strategies for the 21st century. In: K.R. Reddy and H.F. Hodges (eds.) Climate Change and Global Crop Productivity. CABI Press, Wallingford. p. 407-419.

Hong, J.H., D.J. Mills, C.B. Coffman, J.D. Anderson, M.J. Camp, and K.C. Gross. 2000. Tomato cultivation systems affect subsequent quality of fruit slices. J. Amer. Soc. Hort. Sci. 125:729-735.

Horie, T., J.T. Baker, H. Nakagawa, and T. Matsui. 2000. Crop ecosystem responses to climatic change: Rice. Chapter 5. In: K.R. Reddy and H.F. Hodges (eds.) Climatic Change, Plant Productivity and Global Temperature. p. 81-106.

Krizek, D.T., M.J. Camp, S.R. Maxon, G.C. Meyer, J.C. Ritchie, K.M. Davis, and M.L. McCloud. 2000. Comparative germination of 1998 and 1999 lots of Germtec II™ treated eastern gamagrass seed after 28 days in the greenhouse and laboratory. In: J.C. Ritchie, J.A. Dickerson, and C.A. Ritchie (eds.) Proc. Second Eastern Native Grass Symposium. p. 182-193. ARS/NRCS, Beltsville, MD.

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.

Lu, Y-C., K.B. Watkins, J.R. Teasdale, and A.A. Abdul-Baki. 2000. Cover crops in sustainable food production. Food Review Intl. 16(2):121-157.

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Pachepsky, Y., W.J. Rawls, and D.J. Timlin. 2000. A one-parameter relationship between unsaturated hydraulic conductivity and water retention . Soil Science. 165: 911-919.

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Reddy, V.R., M. Boone, Y.A. Pachepsky, and F.D. Whisler. 2000. Validation data bases for crop simulators: Design, assembling, delivery, and use. In: V. M. Salokhe and M. Babul Hossain (eds.). Proc. Intl. Agr. Eng. Conf., Bangkok, Thailand, 4-7 Dec. 2000. p. 472-480.

Reddy, V.R., Y.A. Pachepsky. 2000. Predicting crop yields under climate change conditions from monthly GCM weather projections. Env. Modelling & Software. 15:79-86.

Rhoden, E.G., J.C. Ritchie, D.T. Krizek, and C.D. Foy. 2000. Vegetative propagation of eastern gamagrass: Effects of root pruning and growth media. In: J.C. Ritchie, J.A. Dickerson, and C.A. Ritchie (eds.) Proc. Second Eastern Native Grass Symposium 17-Nov 1999, Baltimore, MD. ARS/NRCS, Beltsville, MD. p. 270-275.

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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.

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Roberts, D.P. 2000. Seedling diseases. In: O.C. Malloy and T.D. Murray (eds.), Encyclopedia of Plant Pathology. John Wiley & Sons, New York, NY. p. 895-896.

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.

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Sainju, U.M., B.P. Singh, S. Rahman, and V.R. Reddy. 2000. Tillage, cover cropping, and nitrogen fertilization influence tomato yield and nitrogen uptake. HortScience 35:217-221.

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.

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Timlin, D.J., Y. Pachepsky, C. Walthall, and S.E. Loechel. 2001. The use of a water budget model and yield maps to characterize water availability in a landscape. Soil and Tillage. 58:219-231.

Wright, S.F. 2000. A fluorescent antibody assay for hyphae and glomalin from arbuscular mycorrhizal fungi. Plant and Soil. 222:171-177.

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