Cover: World agriculture faces the dual challenges of increasing crop production and addressing climate change. Increasing population, diets inclusive of more animal-based foods, and increased manufacture of biobased industrial products will require an increase in crop production of at least 50% by 2050. Agriculture produces approximately 10% of greenhouse gases (GHGs) (CO₂, CH₄, N₂O). Our plant and animal agricultural systems will need to both mitigate production of GHGs and adapt to the stresses of climate change as well as take advantage of the benefits. Research, modeling, policy, ethics and education—as discussed in this volume—will be key to meeting these challenges.
NABC Report 21

Adapting Agriculture to Climate Change

Proceedings of the twenty-first annual conference of the National Agricultural Biotechnology Council, hosted by the College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, Saskatchewan, June 24–26, 2009

Edited by
Allan Eaglesham & Ralph W.F. Hardy

Published by the
National Agricultural Biotechnology Council
Ithaca, New York 14853
The National Agricultural Biotechnology Council provides an open forum for the discussion of issues related to the impact of biotechnology on agriculture. The views presented and positions taken by individual contributors to this report are their own and do not necessarily reflect the views or policies of NABC.

The National Agricultural Biotechnology Council grants permission to copy the Conference Overview and Workshops Summary. Permission to copy other chapters should be sought from the authors.

SALE OF THIS REPORT IN WHOLE OR PART IS PROHIBITED.

Copies of NABC Report 21 are available for $7.50 to cover post and packaging. Please make checks or purchase orders payable to: NABC / BTI.

National Agricultural Biotechnology Council
Boyce Thompson Institute B15
Tower Road
Ithaca, NY 14853

607-254-4856  fax–254-8680
nabc@cornell.edu
http://nabc.cals.cornell.edu

©2009 NABC All rights reserved.
Library of Congress Control Number: 2009942104
National Agricultural Biotechnology Council

Providing an open forum for exploring issues in agricultural biotechnology

NABC, established in 1988, is a consortium of not-for-profit agricultural research, extension and educational institutions.

Member Institutions

Boyce Thompson Institute
Clemson University
Cornell University
Iowa State University
Kansas State University
Louisiana State University
AGC
McGill University
Michigan State University
Mississippi State University
North Carolina State University
North Dakota State University
The Ohio State University
Oklahoma State University
Oregon State University
Pennsylvania State University
Purdue University
South Dakota State University
Texas A&M University
University of Alberta

University of Arizona
University of Arkansas
University of California at Davis
University of Connecticut
University of Florida
University of Georgia
University of Guelph
University of Idaho
University of Illinois at Urbana-Champaign
University of Kentucky
University of Manitoba
University of Minnesota
University of Missouri-Columbia
University of Nebraska-Lincoln
University of Saskatchewan
University of Wisconsin-Madison
US Department of Agriculture/Agricultural Research Service
Washington State University

NABC Reports Available

In Hard Copy

NABC Report 13—Genetically Modified Food and the Consumer (2001)

On CD or from http://nabc.cals.cornell.edu

The above, excluding NABC Report 6, including

ACKNOWLEDGMENTS

NABC’s twenty-first annual meeting—Adapting Agriculture to Climate Change—was hosted by Graham Scoles at the University of Saskatchewan, Saskatoon, Saskatchewan, with superb administrative assistance from Mary Anne Ledsham. We are most grateful to them for a highly successful conference.

Thanks are due to the members of the planning committee1 for an excellent program and first-rate choice of speakers: Graham Scoles (program chair), Malcolm Devine (Performance Plants, Inc.), Ron Kehrig (Enterprise Saskatchewan), Wilf Keller (Genome Prairie), Jerome Konecsni (National Research Council of Canada), Susanne Lipari (NABC), Ian McPhadden (Ag-West Bio, Inc.), Dan Pennock (University of Saskatchewan), Sonny Ramaswamy (Purdue University), Carol Reynolds (Genome Prairie), Andrew Van Kessel (University of Saskatchewan) and Elaine Wheaton (Saskatchewan Research Council).

We thank Susanne Lipari for organizing Student Voice at NABC 21, Colin Kaltenbach (University of Arizona) and Bruce McPheron (The Pennsylvania State University) for serving as workshop facilitators, and Tom Wilson for his services as a workshop recorder.2

Impeccable smoothness of the proceedings resulted from excellent behind-the-scenes efforts of the following members of staff of the University of Saskatchewan:

Hospitality Services: Lynn Guina, Jody Fulcher and Louise Hartz.

Printing Services: Maria Jochmaring and Lori Vershagen.

Educational Media Access and Production (EMAP): Gary Crippen, Frank Harrington, Ginger Koolick, Randy Skurdal, Jin Zhang, Sheri Hupe, Terry Allington, Tim Kolhruss, Pat Thurlbeck and Kelly Thiesen.

Facilities Management: Chris Zbytovsky.

Website Services: Dan Aussant.

Thanks go also to Joan Fior (Sheraton Cavalier), Dwayne Luchyshyn (Saskatoon Transit) and Linda Petrow (Travel Cuts).

On behalf of NABC, we thank Bruce McPheron (The Pennsylvania State University) for his exemplary leadership as NABC’s chair for 2008–2009.

Ralph W.F. Hardy      Allan Eaglesham
President       Executive Director
NABC       NABC

December 2009

1RWFH and AE served on the planning committee.
2AE served as a workshop recorder.
As illustrated on the cover, world agriculture faces the dual challenges of increasing crop production and addressing climate change. Increasing population, diets inclusive of more animal-based foods, and increased manufacture of biobased industrial products will require increased crop production of at least 50% by 2050. Agriculture produces approximately 10% of greenhouse gases (GHGs) (CO₂, CH₄, N₂O). Our plant and animal agricultural production systems will need to mitigate production of GHGs and adapt to the stresses of climate change, as well as take advantages of benefits. A bigger question for agriculture than change itself will be how to deal with the unpredictability of alterations in temperature, precipitation levels and patterns, and growing season and of extreme weather events. Furthermore, the challenges posed by climate change must be met by agriculture as the industry deals with declining reserves of fossil fuels and fertilizers.

NABC’s twenty-first annual meeting brought representatives of academia, industry and government agencies to the campus of the University of Saskatchewan in Saskatoon, Canada, June 24–26, 2009, to address issues that will be key to meeting these challenges: research, modeling, policy, ethics and education. Adapting Agriculture to Climate Change—NABC’s first conference to focus on climate change—stimulated vigorous discussions in the formal plenary sessions and the less-formal “breakout” workshops. The conference was structured in four modules designed to frame the questions and develop insights regarding the issues. Speakers representing expertise in diverse aspects of each topic presented their viewpoints:

Module 1 Climate Change Overview and Projections

2 Genetic Approaches to Crop Adaptation

3 Other Approaches to Adaptation

4 Ethics, Policy, Carbon Credits

Following the plenary presentations in modules 2–4, invited panelists reflected on the speakers’ comments, and all of the modules concluded with comments and questions from the audience. As is traditional for NABC meetings, participants gathered in smaller “breakout” workshops for further discussions of issues raised in the plenary and Q&A sessions.

The Student Voice at NABC program provides grants of up to $750 to graduate students at NABC-member institutions (one student per institution) to offset travel and lodging expenses. Also, registration fees are waived for grant winners. The Student Voice delegates attended the plenary sessions and breakout workshops at NABC 21, and then met as a group to identify current and emerging issues relevant to the conference subject matter¹.

¹Information on the Student Voice at NABC 22 will be available at http://nabc.cals.cornell.edu/studentvoice/.
This volume contains an overview of the conference, a summary of the breakout-workshop discussions, manuscripts provided by the speakers, including the banquet presentation, and the Student Voice report. Transcripts of the panel discussions and Q&A sessions are included.

NABC 22—Promoting Health by Linking Agriculture, Food and Nutrition—will be hosted by the University of California at Davis, June 14–16, 2010\textsuperscript{2}.

Allan Eaglesham
Executive Director
NABC

Ralph W.F. Hardy
President
NABC

\textsuperscript{2}Further information may be accessed at http://nabc.ucdavis.edu/.