Welcome Message

Dear Colleagues and Friends of P²IRC:

Thank you for your participation in our second annual symposium on digital plant phenotyping. Our inaugural symposium in August 2016 was a great success in building cohesiveness across the many disciplines involved. This has been reflected in the past nine months through excellent cross-pillar collaboration between and among plant scientists, soil scientists, engineers, physicists, computer scientists, economists, and other areas of social science. The ability of this group to converse and plan in a "common language" has grown significantly and has been accompanied by energy and enthusiasm from graduate students and postdoctoral fellows across the themes.

It is therefore a pleasure to welcome to the 2017 symposium all of our research groups, members of our International Scientific Advisory Committee, senior researchers from several countries, and industrial colleagues. This year, we are pleased with expanded industrial participation, and we are certain that it will help us to focus on areas that have commercial potential.

The program we have planned will take full advantage of the expert talent of researchers from four continents. At the same time, it gives our local research groups the opportunity to report on exciting progress and to identify the formidable challenges implicit to digital plant phenotyping as we plan for the next five years of investment. This year, we also have a supplementary workshop on "Common Data Standards" with a focus on data sharing and consolidation so that groups around the world can collaborate more easily.

A special thanks goes out to the many people behind the scenes who have worked tirelessly to deliver a great scientific program and seamless logistics for all the participants.

Dr. Maurice Moloney
P²IRC Program Director and Executive Director & CEO, Global Institute for Food Security

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2nd Annual Symposium: 2017

Program Tuesday, June 20

Saskatoon, SK Canada
Delta Bessborough Hotel

Time	Event
7:30 a.m.	Registration and Continental Breakfast
8:45 a.m.	Welcome and Opening Remarks – **Dr. Maurice Moloney**, P²IRC Program Director and Executive Director & CEO, Global Institute for Food Security

9:00 a.m. — *The State of the Art in Plant Phenotyping – Facilities and Ongoing Research*

Dr. Tala Awada: *Application of Plant Phenotyping in Plant Science Research*

Associate Dean, Agricultural Research Division and Associate Director, Nebraska Agricultural Experiment Station, University of Nebraska-Lincoln; Lincoln, Nebraska, USA

Dr. Tala Awada is an Associate Dean/Director in the Agricultural Research Division at the Institute of Agriculture and Natural Resources, a Professor of Plant Ecophysiology in the School of Natural Resources, and a Fellow of the Robert B. Daugherty Global Water for Food Institute, University of Nebraska-Lincoln (UNL). She co-leads the Nebraska Long-term Agroecosystem Research network (ARS/USDA and UNL partnership), and the establishment of the Plant Phenotyping Facilities at UNL. She conducts research, publishes and teaches in the areas of plant ecophysiology, crop abiotic stresses, forest and grassland ecology, ecology of invasive species, and vegetation cover change as impacted by climate variability and change and anthropogenic management. She received her PhD in Plant Sciences at the University of Saskatchewan, Canada; MS in Environmental and Renewable Resources from the Mediterranean Agronomic Institute of Chania, Greece; and BS in Agriculture from the Lebanese University.

Dr. James Schnable: *The Role of High-Throughput Phenotyping in Plant Breeding*

Assistant Professor, Department of Agronomy and Horticulture, University of Nebraska-Lincoln; Lincoln, Nebraska, USA

Dr. James Schnable has spent the last 12 years studying how plants perceive and respond to their environments. His research group at UNL works on developing new methods to share information across groups of crop species and their wild relatives to identify genetic changes that alter the ability of plants to tolerate stress or use resources more efficiently. Projects in his lab are enabled by close collaborations with computer scientists, statisticians, engineers, and applied plant breeders to develop new quantitative genetic and high-throughput phenotyping techniques to analyze novel types of data, including high-throughput RGB and hyperspectral imagery collected from plants on a daily basis and parallel GWAS and selection studies conducted in related grain crop species. Dr. Schnable is currently an assistant professor, affiliated with both the Center for Plant Science Innovation and the Quantitative Life Sciences Initiative.

Moderator: **Dr. Lana Awada**, University of Saskatchewan

Time	Event
10:00 a.m.	Break

10:30 a.m. — *The Transition from Classical Plant Breeding to the Use of Digitized Phenotyping*

Professor Peter Langridge: *Who is Driving Technology Uptake in Plant Breeding?*

Affiliate Professor, School of Agriculture, Food and Wine, University of Adelaide; Adelaide, South Australia, Australia

Professor Peter Langridge is a leading University of Adelaide plant scientist, now emeritus professor, and Australia's Scientist of the Year (2011) who brings his expertise in cereal and plant genomics to P2IRC's International Scientific Advisory Committee. He serves on advisory boards for several research organizations and companies in Europe and North America and is an honorary fellow of Food Standards Australia and New Zealand. Professor Langridge's recent activities have focused on food security and technology delivery to resource-poor farmers in many parts of the world and on Australia's role in supporting global food security.

Dr. Van Ripley: *Short-Term and Long-Term Needs of Commercial Canola Breeders for Enhancing Phenotyping Tools*

Healthy Oils Breeding Leader, Dow AgroSciences; Saskatoon, Saskatchewan, Canada

Dr. Ripley is Research Fellow and Global Breeding Leader of Healthy Oils for Dow AgroSciences (DAS) in Saskatoon, Canada. A leader in developing novel products for producers and consumers, he was the lead canola breeder developing the first registered herbicide tolerant canola variety "Innovator" in Canada in 1995. At DAS, he has developed the first Nexera Omega-9 Clearfield hybrids and Nexera Omega-9 RR hybrids, and led development of ProPound, an advanced canola meal hybrid introduced to the market in 2016. He also leads development of the world's first naturally zero saturated fat oil in sunflowers. Since joining DAS, he's had 13 patents granted related to his novel germplasm and method developments. He obtained his PhD in plant breeding (with Distinction) from the Ontario Agricultural College at the University of Guelph in 1995.

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Tuesday, June 20 (continued)

Saskatoon, SK Canada
Delta Bessborough Hotel

Dr. Kirstin Bett: *Roles for Digital Phenotyping in Public Breeding Programs*

Professor, Department of Plant Science, University of Saskatchewan; Saskatoon, Saskatchewan, Canada

Dr. Kirstin Bett is Professor of Plant Breeding and Genetics in the Department of Plant Sciences, University of Saskatchewan. She teaches courses at the graduate and undergraduate level in plant breeding and plant genetics. She is currently responsible for a common bean breeding program and genomic and genetic research in pulse crops. Two of her pinto beans, a black bean and a yellow bean, are now being grown commercially in western Canada. She has also established a complementary genetics program that uses classical and molecular techniques to better understand the traits that lead to the development of superior pulse crop cultivars. This has included work in seed quality, disease resistance, and cold tolerance and has extended to the use of wild species as a source of useful variability. She has been involved in the development of genomic resources for pulse crops and led the effort to sequence the lentil genome. She currently has a Genome Canada grant to work on the genetics of domestication and adaptation in lentil. Dr. Bett holds a BSc(Agr.) Crop Science from the University of Guelph, an MSc Crop Breeding from the University of Guelph, and received her PhD from the Department of Plant Sciences at the University of Saskatchewan.

Moderator: **Dr. Leon Kochian**, Global Institute for Food Security

11:30 a.m.	Lunch
12:30 p.m.	*The Impact of Transdisciplinary Science on Agriculture and Farming*

Professor Bronwyn Harch: *Digital Agriculture: The Future of Farming*

Executive Director, Institute for Future Environments (IFE) and Professor, Science and Engineering Faculty, Queensland University of Technology; Brisbane, Queensland, Australia

Professor Bronwyn Harch is the Executive Director of the Institute for Future Environments (IFE) and Professor of Applied Statistical Science at Queensland University of Technology. Professor Harch leads transdisciplinary research efforts between industry, government, and the community to address global challenges by generating knowledge, technology, and practices that catalyze sustainability, security, and resiliency in our world. Her career in applied statistics spans 21 years of research, primarily at the nexus of agricultural and environmental systems, and focuses on the statistical design of landscape-scale sampling protocols, monitoring programs, and modeling complex systems.

Chair: **Dr. Maurice Moloney**

1:30 p.m.	*P²IRC's First Year of Progress* Moderator: **Dr. Peter Phillips**, University of Saskatchewan
3:30 p.m.	Break
4:00 p.m.	*Global Food Security: The Impact of Phenomics and Genomics*

Dr. Addie Thompson: *Addressing the Challenges of Global Agriculture Using Advanced Plant Traits*

Postdoctoral Research Associate, Department of Agronomy, Purdue University; West Lafayette, Indiana, USA

Dr. Addie Thompson's research focuses on connecting high-throughput genetics and phenomics to improve drought tolerance in crops. Her work with Dr. Tuinstra to evaluate maize in managed drought stress trials in the desert of Arizona has enabled her to characterize elite lines from public and private breeding initiatives in the US and Mexico, including the Drought Tolerant Maize for Africa program, to elucidate genes and networks contributing to observed differences. Dr. Thompson also works with Purdue engineers, aviation technologists, and computer vision specialists to leverage aerial image data to predict sorghum productivity. In this collaboration, she also works closely with IBM Research for statistical modeling and machine learning expertise, as well as the University of Queensland to innovate new applications of crop models in prediction. She holds a doctorate in plant breeding and molecular genetics from the University of Minnesota and a BS in genetics from Iowa State University.

Chair: **Professor Peter Langridge**

4:45 p.m.	Closing Remarks – **Dr. Maurice Moloney**
5:00 p.m.	Cocktail Networking Reception – **Bessborough Gardens** Poster Viewing Continues – **Conference Foyer**
6:30 p.m.	Move into Adam Ballroom
7:00 p.m.	Dinner Service
8:30 p.m.	Entertainment provided by **The Saskatoon Soaps**

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Wednesday, June 21

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8:00 a.m.	Registration and Continental Breakfast
8:45 a.m.	Opening Remarks – **Dr. Maurice Moloney**

9:00 a.m.

Integrating Root-Soil-Microbial Interactions with High-Throughput Phenotyping Technology for Improved Breeding Outcomes

Dr. Claudia Goyer: *Understanding the Factors Influencing Microbial Communities in Crop Production*

Molecular Bacteriologist, Agriculture and Agri-Food Canada; Fredericton, New Brunswick, Canada

Dr. Claudia Goyer joined Agriculture and Agri-Food Canada in Fredericton in 1999 as a research scientist. Dr. Goyer was awarded the Alexander von Humbold fellowship for a postdoctoral position at the Max-Planck Institute on Terrestrial Microbiology in Marburg, Germany. She studied cold-induced pathogenicity factors in *Erwinia amylovora*, a pathogen causing fire blight of pear and apple trees. Dr. Goyer obtained her PhD in Plant Pathology at the University of Sherbrooke, QC. She studied taxonomy of pathogenic *Streptomyces* causing common scab of potato, a disease responsible for important economic losses every year in Canada. Her current research program focuses on understanding the importance of diversity of microbial communities on plant disease, on soil ecosystem functioning including nitrogen cycling, and on crop productivity. She is investigating how agricultural practices and environmental conditions influence the diversity of microbial communities and soil ecosystem functioning.

Chair: **Dr. Bobbi Helgason**, Agriculture and Agri-Food Canada; Saskatoon, Saskatchewan, Canada

9:30 a.m.

The State of the Art in Biological Imaging and Emerging Opportunities

Professor Victor Malka: *Manipulating Relativistic Electrons with Lasers*

Research Director at Laboratoire d'Optique Appliquée, CNRS, ENSTA, Ecole Polytechnique, Palaiseau, France; and Professor at Weizmann Institute of Science, Rehovot, Israel

Professor Victor Malka graduated from University of Paris XI-Orsay, did his PhD thesis at Ecole Polytechnique (1987-90), is a CNRS research director at Laboratoire d'Optique Appliquée, and since 2015 a Professor at the Weizmann Institute for Science. He has also been Professor at Ecole Polytechnique (2003-2015). Victor Malka worked on different topics such as atomic physics, inertial fusion, and laser plasma interaction. His work now is mainly devoted to relativistic plasmas and laser plasma accelerators, in which he makes several breakthrough contributions. He has published about 340 articles and has been invited to more than 175 international conferences. He received several national and international prizes including in 2017 the Julius Springer prize, the QEOD prize for EPS, and the F. Holweck prize from the SFP and IOP. Since 2002, he has coordinated many European projects structuring the laser, plasma and accelerators communities. Victor Malka, fellow of APS and EPS, got two Advanced and two Proof of Concept grants from ERC.

Chair: **Dr. Jean-Claude Kieffer**, Institut National de la Recherche Scientifique, Quebec City, Quebec, Canada

10:00 a.m.	Break

10:30 a.m.

Customizing Robotics and Sensors for Crop Field Trials

Dr. Kelly Thorp: *Field-based Plant Phenotyping Devices: Data Collection/Management Strategies*

Research Agricultural Engineer, USDA Agricultural Research Service, US Arid-Land Agricultural Research Center; Maricopa, Arizona, USA

For 17 years, Dr. Thorp has actively pursued research to develop informational technologies to understand cropping system processes, improve management of water and nutrients for crop production, and enhance plant breeding and genetics research. Specific application areas for these information technologies include crop water and nitrogen status assessment, precision agriculture, management of nitrogen fertilizer, irrigation and drainage water management, high-throughput field-based plant phenomics, and development of new bioenergy crops. He received BS and MS degrees in Agricultural Engineering from the University of Illinois at Urbana-Champaign in 2000 and 2002, and he obtained a PhD in Agricultural Engineering from Iowa State University in 2006. Since then, Dr. Thorp has been employed by the USDA Agricultural Research Service, including a 10-month post-doc at the National Center for Agricultural and the Environment in Ames, Iowa, followed by 10 years of service at the Arid-Land Agricultural Research Center in Maricopa, Arizona.

Chair: **Professor Bronwyn Harch**

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Wednesday, June 21 (continued)

Saskatoon, SK Canada
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11:00 a.m.	### *Regulation of Big Data and Open Data Concepts* **Professor Jeremy de Beer,** *Who Owns Open Ag Data?* **Professor of Law, University of Ottawa, Ottawa; Ontario, Canada** Mr. Jeremy de Beer is a Professor of Law at the University of Ottawa's Faculty of Law where he creates and shapes ideas—about technology innovation, intellectual property, and global trade and development. As an award-winning professor, Professor de Beer is recognized for exceptional contributions to research and law teaching, whose current work helps solve practical challenges related to innovation in the digital economy, life science industries, and clean technology sector. He is also a practicing lawyer and expert consultant, having argued numerous cases before the Supreme Court of Canada, advised businesses and law firms both large and small, and consulted for agencies from national governments and the United Nations. Chair: **Dr. Lana Awada**
11:30 a.m.	Lunch
12:30 p.m.	### Workshop: *The Bottom Line: Sustainable Infrastructure for Delivering Multidisciplinary Phenotyping Technologies to Breeders* Panel Presenters: **Dr. Bobbi Helgason**, Agriculture and Agri-Food Canada **Dr. Scott Noble**, University of Saskatchewan **Dr. Ralph Deters**, University of Saskatchewan **Professor Dave Schneider**, Global Institute for Food Security Chair: **Dr. Claudia Goyer**
1:45 p.m.	Break
2:15 p.m.	### Workshop: *Innovative Technologies: Visualizing Whole Plants 'in situ' with Advanced Probes and Autonomous Vehicles* Panel Presenters: **Dr. Jean-Claude Kieffer**: *Biological Imaging Using the Laser Wakefield Betatron Beam Line* **Dr. Emil Hallin**, Global Institute for Food Security: *Biological Imaging Using Thermal Neutrons* **Dr. Nicholas Brereton**, Université de Montréal; Montreal, Quebec, Canada: *Applications of Non-Invasive Imaging in Plant Breeding* **Dr. Reza Fotouhi**, University of Saskatchewan: *Advances in Field-Based Phenotyping Mobile Platforms* **Dr. Anh Dinh**, University of Saskatchewan: *New Hybrid Laser Technology for 3D Plant Reconstruction* Chair: **Professor Victor Malka**
3:45 p.m.	Closing Remarks – **Dr. Maurice Moloney**
3:45 p.m. to 4:45 p.m.	Poster Judging – Students must be present
4:45 p.m.	Walk to Saskatoon Farmer's Market; 2 km along scenic South Saskatchewan riverbank (transportation available where necessary or if inclement weather)
5:00 p.m. to 8:00 p.m.	Flavour of the Prairies Market Stroll **Saskatoon Farmer's Market; 414 Avenue B South**
7:00 p.m.	Announcement of P²IRC Student Poster Competition Winners

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Thursday, June 22

Saskatoon, SK Canada
Delta Bessborough Hotel

8:00 a.m.	Registration and Continental Breakfast
8:30 a.m.	Welcome and Opening Remarks – **Dr. Maurice Moloney**, P²IRC Program Director and Executive Director & CEO, Global Institute for Food Security

8:45 a.m.

The Need for Common Data Standards and the Challenges this Presents

Professor Tony Pridmore

Professor of Computer Science, Faculty of Science, University of Nottingham; Nottingham, United Kingdom

Professor Tony Pridmore leads the Computer Vision Laboratory at the University of Nottingham where he works to develop integrated plant phenomics technologies. He is a founder and managing member of the University's Centre for Plant Integrative Biology and is co-director of the Hounsfield Facility, an installation providing automated extraction of 3D structural descriptions of plants from X-ray data. Professor Pridmore also co-chairs the UK Plant Phenotyping Network and is a co-organizer of the Imaging and Image Analysis Working Group of the International Plant Phenotyping Network.

Dr. Ralph Deters

Professor, Department of Computer Science, University of Saskatchewan and Project Co-Lead,
Web Applications and Collaboration, P²IRC Project; Saskatoon, Saskatchewan, Canada

Ralph Deters is a Professor in the Department of Computer Science at the University of Saskatchewan. Ralph obtained his PhD in 1998 from the federal Armed Forces University in Munich and joined the University of Saskatchewan as a research associate the same year. His research focuses on the study and development of software infrastructure(s)/middleware to ensure that users of a mobile device are first-class citizens within IT systems.

9:30 a.m.

Plant Imaging Data and the Need for Models and Archetypes

Dr. Maurice Moloney

P²IRC Program Director and Executive Director & CEO, Global Institute for Food Security

Maurice Moloney was appointed Executive Director and CEO of the Global Institute for Food Security in 2014. He also serves as Program Director for the University of Saskatchewan's Plant Phenotyping and Imaging Research Centre (P²IRC), which is managed by GIFS.

Previously, Maurice served as Group Executive, Food, Health and Life Sciences, CSIRO, Australia, and Director and Chief Executive of Rothamsted Research in the UK, the oldest and largest agricultural research centre in Europe. He founded SemBioSys in 1994 and served as its President and then CSO until 2010. Concurrently Maurice was a Professor of Biological Sciences at the University of Calgary and held the NSERC Industrial Research Chair in plant biotechnology.

Maurice began his North American career as Head of the Cell Biology Group at Calgene Inc. where he developed the first transgenic canola plant. Maurice has published over 90 research papers and is inventor on 300+ patents worldwide. He holds a BSc in chemistry, a PhD in plant biochemistry, and was awarded a DSc honoris causa from universities of De Montfort, Lethbridge, and Lancaster.

Dr. Michael Selvaraj

Crop Physiologist, International Center for Tropical Agriculture (CIAT), CGIAR Research Center; Cali, Colombia

Climate change is a major and crucial development challenge since the majority of those affected live in poor countries. Because the phenomenon has profound effects on agricultural development and future food security, and the fact that those effects are projected to become worse, CGIAR is highly committed to incorporating climate change adaptation and mitigation research into ongoing activities. Within this framework, Dr. Michael Selvaraj's research aims to develop a platform to increase the accuracy, precision, and throughput of phenotypic estimation of plant traits while reducing costs and minimizing labor through automation, remote sensing, improved data integration, and experimental design. At CIAT, Michael Selvaraj's team is implementing cutting-edge phenotyping tools for improving the eco-efficiency of crops amid global climate change, by establishing robust/precise phenotyping tools and screening methods and integrating hi-tech remote sensing tools. Apart from the above-ground plant traits characterization, his team also came up with breakthrough ground penetrating radar technologies to quantify real time root biomass.

Moderator: **Dr. Tala Awada**

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Thursday, June 22 (continued)

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10:15 a.m.	Break
10:45 a.m.	***The Complexity of Provenance and Annotation***

Professor Mario Caccamo

Head of Crop Bioinformatics, National Institute of Agricultural Botany (NIAB); Cambridge, United Kingdom

Professor Mario Caccamo is the Head of Crop Bioinformatics at the National Institute of Agricultural Botany and has over 15 years of experience in life science research and big data. His work includes the application of DNA sequencing technologies and bioinformatics methods to the study of crop genetics and interactions between agricultural crops and their environments. He led work on the assembly of the first whole-genome release of the wheat reference sequence and helped found the Wheat Initiative's expert working group focused on an international Wheat Information System.

Dr. Tony Kusalik

Professor, Department of Computer Science, University of Saskatchewan and Project Co-Lead, Data-Driven Genomic-Phenomic Linkages, P²IRC Project; Saskatoon, Saskatchewan, Canada

Dr. Anthony (Tony) Kusalik is a professor in the Department of Computer Science at the University of Saskatchewan, a member of the Division of Biomedical Engineering, Director of the Bioinformatics Program, and Director of the Bioinformatics and Computational Biology Research Laboratory. Professor Kusalik's research interests range from logic programming to machine learning to computational biology. However, his primary research interests center on bioinformatics. He works extensively with collaborators in a broad spectrum of life and health sciences.

Co-presenters: **Mr. Morgan Kirzinger**, University of Saskatchewan
Ms. Kimberly MacKay, University of Saskatchewan
Ms. Katie Ovens, University of Saskatchewan

11:30 a.m.	Lunch Presentation **Dr. Ralph Deters**: *Linked Data and Self-Describing Web Services*

Break-Out Discussions

1:00 p.m.	**The Challenges in Our Need for Common Data Standards**	**Plant Imaging Data: Why we Need Models and Archetypes**	**The Complexity of Provenance and Annotation**

3:30 p.m.	***Lessons Learned and Framing Future Challenges*** Chairs: **Professor Peter Langridge** and **Dr. Isobel Parkin**, Agriculture and Agri-Food Canada; Saskatoon, Saskatchewan, Canada
4:30 p.m.	Closing Remarks – **Dr. Maurice Moloney**