MONDAY, JUNE 7, 2021

Session 1: Breeding for Organic Production Systems
Moderator - Rick Boyles

1:00 PM  Breading Away from All-Purpose  Stephen Jones
1:45 PM  Value Added Grains for Local and Regional Food Systems  Mark E. Sorrells
2:30 PM  Organic Wheat Breeding for Artisanal Bread Making Quality  Julie Dawson
3:15 PM  SCOPE: Letting Students Run Breeding Programs and Develop Cultivars  Charlie Brummer

4:00 PM  End of Session

TUESDAY, JUNE 8, 2021

Session 2: Biofortification & Nutrition
Moderator – Dil Thavarajah

1:45 PM  Crossroads and Opportunities: Agriculture and Food Systems, Human Nutrition, and Biofortification  Casey Johnson
2:30 PM  From Seed Bank to Staple Food: Pipeline for Cereal Biofortification  Davina Rhodes
3:15 PM  Breeding Pea for the Farm and the Market  Tom Warkentin

4:00 PM  End of Session

WEDNESDAY, JUNE 9, 2021

Session 3: Breeding Techniques, Molecular Mapping, and Genomic Prediction
Moderator - Rick Boyles

Breakout 1: Genomics & Mapping

1:00 PM  Processing Raw Genomic Data  Lucas Boatwright
1:20 PM  Diversity Analysis & Relationship Matrices  AJ Ackerman

1:40 PM  BREAK

1:45 PM  Genetic Mapping Strategies Across Populations  Sirjan Sapkota
2:05 PM  Genomic Prediction Models & Implementation  Rick Boyles

2:25 PM  BREAK
WEDNESDAY, JUNE 9, 2021

Breakout 2: Cross-pollination Methods

2:35 PM  Overview of Clemson Sorghum Breeding Program  
Rick Boyles

2:55 PM  Sorghum Crossing Schemes and Procedures  
AJ Ackerman

3:15 PM  BREAK

3:20 PM  Overview of Clemson Wheat Breeding Program  
Rick Boyles

3:40 PM  Wheat Crossing Schemes and Procedures  
Neeraj Kumar

4:00 PM  End of Session

THURSDAY, JUNE 10, 2021

Session 4: Pulse Breeding, Organic Management, and Nutritional Phenotyping

Breakout 1: Pulse Breeding

Moderator – Emerson Shipe

1:00 PM  Breeding Lentil Varieties for Organic Agriculture  
Shiv Kumar

1:20 PM  Breeding Pulse Crops for Organic Systems  
Rebecca J. McGee

1:40 PM  Clemson University Organic Pea Trials & Breeding  
Tristan Lawrence

2:00 PM  Panel: Shiv Kumar, Rebecca J. McGee, Dil Thavarajah, and Tristan Lawrence

2:35 PM  BREAK

Breakout 2: Biofortification and Nutritional Analysis/Phenotyping

Moderator – Dil Thavarajah

2:45 PM  Advanced Spectroscopy and Imaging Techniques  
Chithra Karunakaran

3:15 PM  Prebiotic Carbohydrate and Amino Acid Analysis – HPLC  
Nathan Johnson

3:30 PM  Fatty Acid Analysis – GCMS  
Amod Udayanga

3:45 PM  Mineral Analysis – ICP-EMS  
Dil Thavarajah

4:00 PM  End of Session
Stephen Jones
Washington State University
*Clif Bar and King Arthur Endowed Chair in Organic Grain Breeding and Innovation*

Dr. Jones has a PhD in Molecular Cytogenetics from UC Davis. He has been breeding wheat since 1991 and is the founder of the Washington State University Breadlab. He and his students and staff develop highly diverse non-commodity grains designed for highly diverse farming systems and a changing climate.

“Breading Away from All-Purpose”
The talk will cover the breeding of high-yielding modern Land Race populations of wheat, barley, rye and buckwheat without having the pressures of predefined types as required for commodity markets. Flavor, nutrition, affordability and novelty are breeding targets added to the traditional goals of yield, disease resistance and adoptability. The relatedness and maturity of regional, national and international food movements designed to keep value where it is produced will also be discussed.

Mark E. Sorrells
Cornell University
*Professor of Plant Breeding and Genetics*

Mark Sorrells is Professor of Plant Breeding and Genetics in Plant Breeding and Genetics at Cornell University. He earned his Ph.D. in Plant Breeding and Plant Genetics in 1978 at the University of Wisconsin, Madison. He joined the Department of Plant Breeding and Biometry in 1978 and has been full professor of plant breeding since 1991. Sorrells has authored or co-authored more than 300 peer reviewed publications. He specializes in plant breeding methodologies and strategies and develops new varieties of wheat, oats, and barley.

“Value Added Grains for Local and Regional Food Systems”
Diversity is essential to sustainability of organic farms, to improve and maintain soil health, manage diseases and pests and sustain whole-farm economic viability in spite of climate change and market instability. However, the need for an adequate return per acre has worked against diversity on many organic farms, leading to shortened and simplified rotations on vegetable farms that often precludes crop rotation and sufficient use of cover crops. Our project will add value and knowledge in the production and marketing of specialty food grain crops to improve farm economics with the goals of increasing their utilization and enhancing the biodiversity and sustainability of organic farms. The long-term goal of the multi-region, integrative project is to provide organic growers, processors and consumers with new knowledge about food grains that will lead to economically rewarding and sustainable organic farms.
SPEAKERS

Julie Dawson
University of Wisconsin-Madison
Associate Professor

Julie Dawson is an Associate Professor in the Department of Horticulture at the University of Wisconsin-Madison. Her background is in organic plant breeding and participatory research. Research topics include season extension methods, organic and participatory variety trials and variety selection for small-acreage farms and gardens as well as extension resources for urban growers. She leads a project called the Seed to Kitchen Collaborative with other plant breeders to test varieties with local farmers and chefs, focused on flavor for local food systems.

“Organic Wheat Breeding for Artisanal Bread Making Quality”
Regional grains systems depend on having well-adapted varieties that perform well for farmers, millers, and bakers. Several small grains breeding programs across the country are working to develop varieties that have excellent performance in organic systems and for artisanal products. The organic wheat breeding efforts at University of Wisconsin-Madison are in collaboration with Cornell University, the University of Vermont, the University of Maine and the University of Illinois. These programs rely on collaborations with farmers, millers, bakers and other processors to test and select the best varieties. These participatory on-farm trials and baking trials are very important to ensuring the varieties meet the needs of organic farmers and regional grains systems. We will present both the methodology used for this approach and the results of the latest trials and baking tests.

Charlie Brummer
University of California-Davis
Director, Plant Breeding Center; Professor, Plant Sciences Department

Dr. Brummer is the Director of the Plant Breeding Center and a Professor in the Department of Plant Sciences at the University of California, Davis. His research includes cultivar improvement and genetic analysis of alfalfa, tall fescue, spinach, hemp, and zinnia. His lab conducts research on improving breeding methodologies for outcrossing crops, on applying genetic markers to practical plant improvement programs, and on using genomics to understand the genetic control of important traits. He teaches Advanced Plant Breeding and leads the Student Collaborative Organic Plant-breeding and Education program, which includes several student-led breeding projects. He has published over 160 refereed journal papers and presented numerous invited talks nationally and internationally. He was President of the Crop Science Society of America (CSSA) in 2017 and served as Editor-in-Chief of CSSA from 2010-2016. He is a Fellow of CSSA and of the American Association for the Advancement of Science.

“SCOPE: Letting Students Run Breeding Programs and Develop Cultivars”
In this talk, I will describe the SCOPE program I lead at UC Davis. SCOPE, or the Student Collaborative Organic Plant breeding and Education project, is funded by the NIFA-OREI program. The purpose of the project is to provide graduate and undergraduate students with hands-on opportunities to learn about plant breeding, from germplasm acquisition and hybridization to field plot development and cultivar release. I will explain how we have developed the project over the past five years, describe what’s worked and what hasn’t, and present several success stories. I will then discuss future plans and opportunities for expanding the program to other schools and situations.
Casey Johnson
Mayo Clinic
Resident Physician

Casey Johnson is a Resident Physician in the Department of Pediatric and Adolescent Medicine at the Mayo Clinic. He has a research background in pulse crops and their relation to human nutrition. He has a passion for recognizing, understanding, researching, treating, and preventing malnutrition. Much of his work has surrounded micronutrient malnutrition, especially in low- and middle-income countries.

“Crossroads and Opportunities: Agriculture and Food Systems, Human Nutrition, and Biofortification”
A century of agricultural interventions dramatically reduced world hunger, yet childhood malnutrition persists and, in some cases, has worsened. Food systems have struggled to adapt to rapidly changing technological advances. Biofortification emerged as a viable strategy to combat micronutrient malnutrition, and work over the past few decades has shown significant promise. In this session, I will review a timeline of agricultural advances and food systems-related nutritional dilemmas; provide an overview of biofortification, discussing several success stories among pulse crop candidates; and identify opportunities and avenues of future work.

Davina Rhodes
Colorado State University
Assistant Professor

Dr. Rhodes’s research is focused on understanding the genetics of crop nutritional traits in order to help breeders develop healthier staple crops. She uses tools from crop genetics, analytical chemistry, and human nutrition to strategize and carry out crop biofortification, particularly for sorghum carotenoids. Her long term mission is to reduce malnutrition through biofortification.

“From Seed Bank to Staple Food: Pipeline for Cereal Biofortification”
While cereals provide the majority of calories in the human diet, they are low in several essential nutrients. An increase in key cereal nutrients can significantly impact global food security by decreasing malnutrition. In this session, I will discuss the path to nutritionally enhanced cereal crops, including developing partnerships and identifying target values, screening germplasm collections, and characterizing genetic architecture to determine breeding strategies. Real world examples will be used to demonstrate how this cross-disciplinary and participatory approach to cereal biofortification is proving to be successful in chipping away at global malnutrition.
Tom Warkentin

University of Saskatchewan

Professor

Professor in the Crop Development Centre/Department of Plant Sciences, University of Saskatchewan, Saskatoon, Canada. Focus is on plant breeding of field pea and related research. Also a smaller breeding and research program on soybean for the shortest season regions in the continent.

“Breeding Pea for the Farm and the Market”

This presentation will describe breeding and research related to field pea in the Canadian and northern USA context. It will include aspects of agronomy, disease resistance, and nutritional quality.

Shiv Kumar AGRAWAL

ICARDA

Legumes Team Leader

Dr. Kumar is leading ICARDA’s Food legumes program from Rabat, Morocco which aims to deliver improved germplasm of lentil, kabuli chickpea, faba bean and grass pea to national partners in South Asia, Sub-Saharan Africa, West Asia, and North Africa. He works on developing short duration climate smart varieties of lentil and grass pea with high iron and zinc content for sustainable intensification of cereal based cropping systems. His contribution in identifying donors for new plant type in rice, extra early genotypes in chickpea, lentil, and mung bean, basic information on genetics of important traits, and pre-breeding populations in Vigna, Lens and Lathyrus species, are noteworthy.

“Breeding Lentil Varieties for Organic Agriculture”

Lentil (Lens culinaris ssp. culinaris Medik) is an excellent food legume crop for organic agriculture because of its ability to meet its nutrient requirement through symbiotic relationship with beneficial microbes and to produce protein rich grains with low carbon and water footprints in low input environments. Being rich in protein, prebiotics and micronutrients, and exceptional local adaptation to prevailing agro-ecological conditions, this crop is extensively grown by small-holder farmers in developing countries whereas in developed countries, it is considered as an option to increase the sustainability of cereal based cropping systems. The latest triennium average suggests that the global production of lentil is 6.28 million tons from 5.40 million ha area mainly cultivated in conventional farms. The current trend in the demand for organic foods shows that the organic lentils could potentially occupy up to 1 m ha area which will create strong demand for improved varieties well adapted to organic farming systems. At present, there are hardly any specific breeding efforts towards developing varieties for organic farming. Most of the varieties presently cultivated in organic agriculture are developed from high-input breeding programs and adapted to conventional farming systems. Comparative trials have indicated that these mainstream varieties exhibit lower yield and poor adaptability under organic systems. Therefore, there is a need to reorient the breeding strategies based on the principles of organic agriculture. This may include fast track the mainstream varieties developed through conventional plant breeding methods such as ILL590 and FLIP/03-12L by multiplying their seeds organically and deploying them for organic farming. Secondly, we initiate development of specific breeding product profiles based on traits that are important for organic farming systems such as early growth vigour, deep root system, vigorous and competitive plant type, high nitrogen fixing ability and input use efficiency, resistance against diseases and insect pests, local adaptation to environmental challenges, high nutritional value, authentic taste and local flavor, etc. The sources of variation to incorporate relevant traits in organic cultivars need to be sought from local varieties, landraces, and crop wild relatives. Genetic gain for organic varieties can be accelerated by undertaking breeding activities along the breeding and testing pipeline such as crossing, generation advancement, selection, evaluation, and multiplication exclusively under the low input conditions representing the target environments of organic farming. This may include either organic fields at the breeding station or involving organic farmers in participatory mode. Participatory plant breeding and evolutionary breeding have been proposed as suitable breeding methods to target organic lentils as these methods facilitate the selection for local adaptation, local needs, and faster adoption.
“Breeding Pulse Crops for Organic Systems”
This presentation will discuss the USDA ARS pulse crop breeding program and the efforts directed at breeding for organic systems. Currently, the primary focus of my organic breeding program is autumn-sown food quality peas and lentils adapted to the dry regions and autumn-sown peas for the cover crops. A nascent part of the program is breeding autumn-sown chickpeas for the small kabuli market. We are focusing on autumn-sown pulse crops for organics because of their ability to form dense, weed-excluding canopies, their water-use efficiency, and, of course, their tremendous yield and biological nitrogen fixation potentials. The breeding program will be discussed and examples of successes (and failures) presented.

“Advanced Spectroscopy and Imaging Techniques”
Synchrotrons produce tunable beams of X-rays and infrared light used by researchers to understand the structure (X-ray imaging) and nature (X-ray or infrared spectroscopy) of molecules in samples. Synchrotron based imaging and spectroscopy can be applied to study any plant or food samples from macro to nano-scale with no or minimal sample preparation. The synchrotron techniques have high detection sensitivity for the molecules of interest compared to laboratory methods due to a combination of a brilliant light source and state of the art detectors. The Canadian Light Source (CLS) is one of the leading synchrotrons in the world that has suites of experimental stations to characterize plants and food samples. One of the CLS unique experimental stations in North America is used for the non-destructive three-dimensional characterization of seeds, plant root systems, and food samples. Examples will be shown on how the synchrotron techniques are used for chemo-phenotyping of biofortified peas. Details on the access mechanisms to this facility for academic researchers through different service programs will be also presented.
ORGANIZING COMMITTEE

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Pulse Lead

Rick Boyles
Cereal Lead

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Tristan Lawrence
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ACKNOWLEDGMENTS

- USDA National Institute of Food and Agriculture (NIFA)
- Clemson University College Of Agriculture (CAFLS)
- Pee Dee Research and Education Center (REC)
- Clemson Student Organic Farm
- Walter P. Rawl & Sons

United States Department of Agriculture
National Institute of Food and Agriculture

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AND LIFE SCIENCES