98th Annual Meeting of the Potato Association of America

SPOKANE, WASHINGTON
JULY 27-31

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In an effort to keep your conference registration fee reasonable, the companies above contributed a total of over $50,000. If they had not subsidized this conference, your registration fee would have been significantly higher. Please thank people from these companies whenever possible.

NOTES

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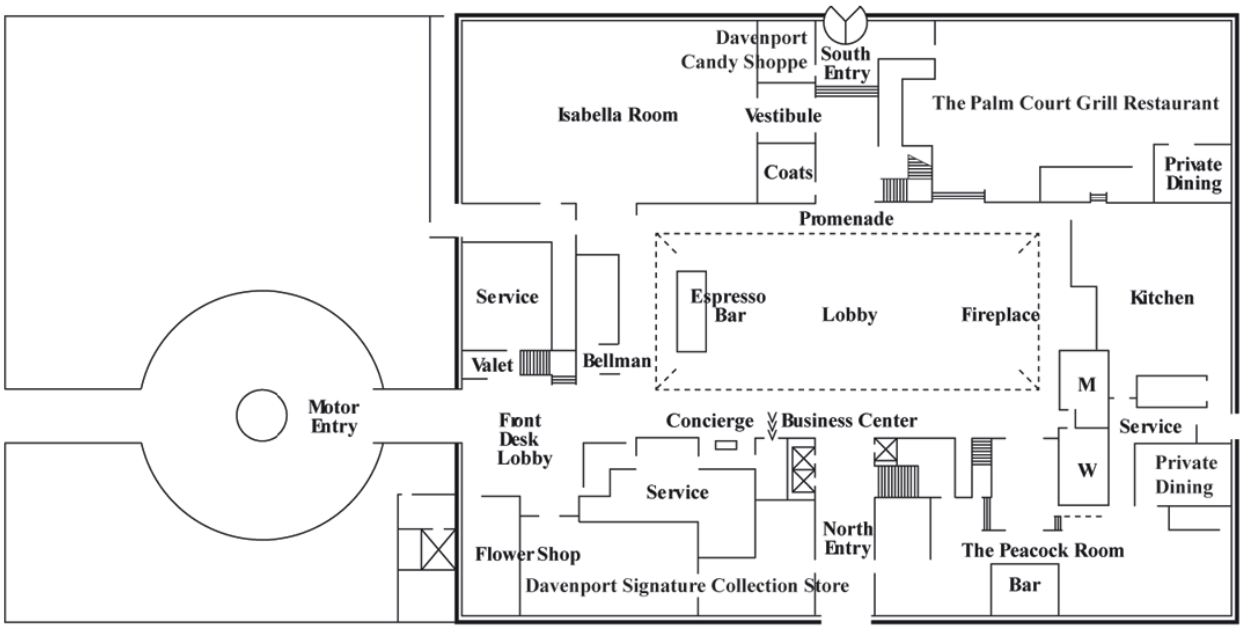
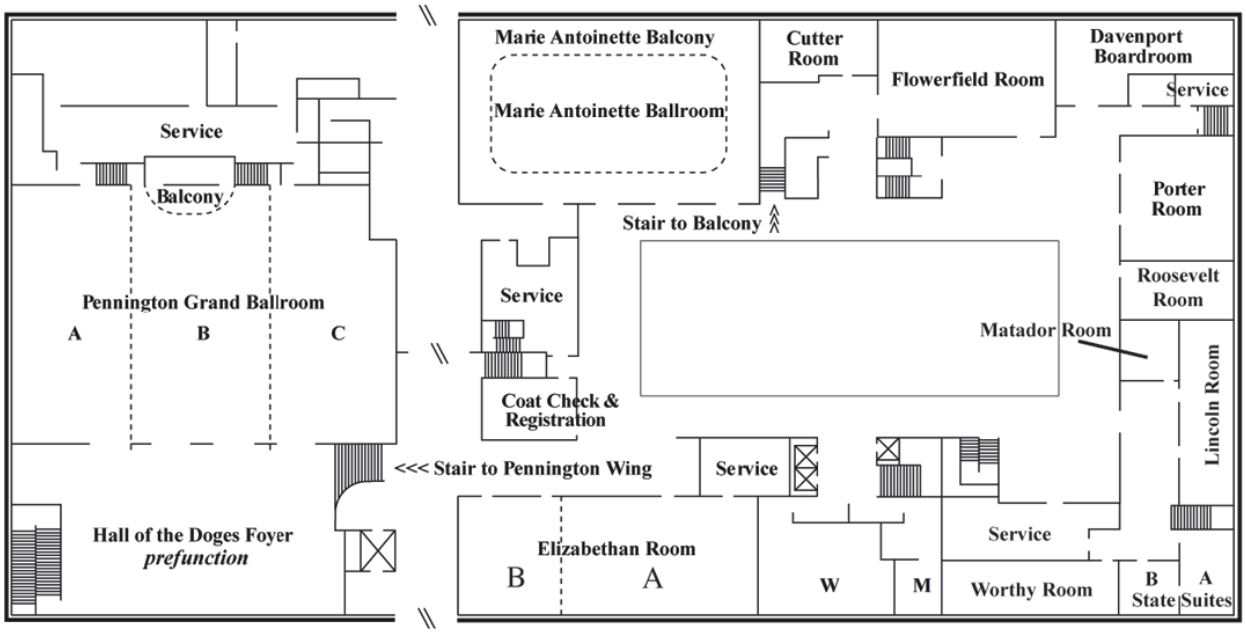
FLOOR PLAN

THE DAVENPORT HOTEL and Tower



FIRST FLOOR ▲ SECOND FLOOR ▼



PAA PRESIDENT'S WELCOME MESSAGE

Welcome to the 98Th Annual Meeting of The Potato Association of America.It is with great pleasure we welcome you to Spokane, Washington. The collective effort of the Washington Local Arrangements Committee, co-chaired by Dr. Mark Pavek and Raina Spence in conjunction with numerous Washington State University faculty and staff and Washington potato industry representatives, have organized a perfect venue for our annual meeting.

After celebrating our 100th year as an association last year, we are moving forward strongly into our next 100 years. The Davenport Hotel in Spokane is a fitting venue for us to come together, reflect on the scientific foundation those previous 100 years have provided, and pilot the association efforts for the next century. Our venue is entrenched in history and culture, yet the people here sought a vision and were the first in something new. Here are a few fun and interesting facts about this area:

- In 1974, Spokane was the smallest city to have held a World's Fair, "Expo '74". It was the first World's Fair with an environmental theme and unveiled the world's first IMAX theatre and movie. As a native Spokanite, I was able to embrace Expo '74 as a little girl and I will never forget the garbage eating goat. Check it out in Riverfront Park.
- Constructed in 1914, The Davenport Hotel was designed by Kirtland Cutter and the first hotel to have air-conditioning, a central vacuum system, and housekeeping carts.
- There is strong evidence that the "Crab Louie" was conceived and first served at the Davenport Hotel and actually named after Louie Davenport.

This bridging of historical preservation and novel innovation is similar to what we are accomplishing this week. Each annual meeting builds upon previous knowledge and pushes us to foster new ideas, technologies and methods for global potato improvement. Our symposium this year is "Bringing New Potato Varieties to Market" sponsored by the Marketing and Utilization Section and is an excellent example of advancing our industry with innovative science and application.

This meeting has the special designation of having an invited international visitor, Dr. Anton Haverkort of the Netherlands, sponsored by the International Relations Committee with generous funds designated and donated by the Colorado LAC. Please introduce yourself and welcome Dr. Haverkort to the meeting.

We give a special thanks and best wishes to the 18 graduate students who are participating in the Frank L. Haynes Graduate Student Competition.The financial support from contributors to the PAA does not go unnoticed and is sincerely appreciated. Their support of this meeting helps foster the cooperation, collaboration and exchange of information and ideas that will move potato science forward. Please take a moment to thank our sponsors during the conference.The camaraderie of PAA members is like no other. If you are new to the meeting, welcome to the family.

Nora Olsen
President 2013-2014, The Potato Association of America

A WORD FROM THE LAC CO-CHAIRS

Welcome PAA 2014 Participants!

Welcome to wonderful Spokane, Washington, The Davenport, and the 98th Annual Meeting of The Potato Association of America. We thank each of you for coming and sharing this week with us. The importance of potato production in Washington cannot be overstated. The potato industry contributes $4.6 billion to the state economy and creates an estimated 23,500 jobs. Last year, 160,000 acres of potatoes were harvested in Washington with an average yield of 600 CWT/A (42% higher than the average yield in Idaho!). Potatoes rank third behind apples and wheat as the most valuable crop in Washington and account for 21% of total U.S. potato production. Approximately 87% of Washington's crop is long russet cultivars which are processed into French fries. Stewardship decisions and cultural management recommendations are based upon the legacy of scientific research and outreach conducted by many of those involved in the PAA. We are pleased to host you and thank you for your tireless contributions to the industry.

As you can see from the agenda, we have an exciting and informative program. In addition to providing our regional growers and industry professionals an opportunity to learn all about PAA through our Industry Day, we look forward to interacting with everyone during the meeting. PAA provides a unique opportunity to share ideas, mentor graduate students, and inspire each other in our chosen career paths. We are pleased to serve the PAA by organizing this conference and hope you enjoy your time with us. Please let us know if there is anything that we can do to make your stay more enjoyable. We are happy to assist and glad you came. For a membership that often feels like family, we welcome you to our home!

Sincerely,

Mark Pavek and Raina Spence, 2014 PAA LAC Co-Chairs

PROGRAM AT A GLANCE

SUNDAY, July 27, 2014		**Location**
7:00 a.m.–3:00 p.m.	Golf Tournament ***(sponsored by Syngenta)***	*Off-site*
9:00 a.m.–12:00 p.m.	Finance & Endowment Fund Comm.	*Davenport Boardroom*
12:00 p.m.–6:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
12:00 p.m.–6:00 p.m.	Silent Auction *(begin receiving items)* *(moves to Grand Pennington B on Monday afternoon)*	*Grand Pennington BC**
1:00 p.m.–5:00 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*
6:30 p.m.–9:00 p.m.	President's Reception ***(sponsored by Washington State Potato Commission)***	*Grand Pennington*

MONDAY, July 28, 2014		
6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast ***(sponsored by RDO)***	*Marie Antoinette & Flowerfield Room*
7:00 a.m.–8:20 a.m.	Editorial Board Meeting *(breakfast in meeting room)*	*Worthy Room*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
8:15 a.m.–10:00 a.m.	WELCOME & SYMPOSIUM 2014 ***(sponsored by AMVAC)***	*Grand Pennington AB*
8:30 a.m.–4:30 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*
10:00 a.m.–10:30 a.m.	***Break*** ***(sponsored by Gowan)***	*Hall of the Doges*
10:00 a.m.–5:30 p.m.	Poster Session Setup	*Hall of the Doges*
10:30 a.m.–12:00 p.m.	SYMPOSIUM (*continued*)	*Grand Pennington AB*
12:00 p.m.–1:00 p.m.	Site Selection Committee Meeting	*Cutter Room*
12:00 p.m.–1:30 p.m.	**Lunch** ***(sponsored by Syngenta)***	*Marie Antoinette*

	CONCURRENT SESSIONS	
1:30 p.m.–2:45 p.m.	Plant Protection	*Grand Pennington A*
1:30 p.m.–2:45 p.m.	Breeding and Genetics	*Grand Pennington C*
2:45 p.m.–3:15 p.m.	***Break*** ***(sponsored by Pure Potato LLC)***	*Hall of the Doges*
	CONCURRENT SESSIONS (*continued*)	
3:15 p.m.–4:15 p.m.	Plant Protection	*Grand Pennington A*
3:15 p.m.–4:00 p.m.	Breeding and Genetics	*Grand Pennington C*
	SECTION MEETINGS	
4:15 p.m.–5:30 p.m.	Breeding and Genetics Section Meeting & Sponsored Special Seminar	*Grand Pennington C*
4:30 p.m.–5:30 p.m.	Plant Protection Section Meeting	*Lincoln Room*
4:30 p.m.–5:30 p.m.	Physiology Section Meeting	*Porter Room*
4:30 p.m.–5:30 p.m.	Utilization and Marketing Section Meeting	*Grand Pennington A*
4:30 p.m.–6:00 p.m.	Graduate Student Awards Committee	*Cutter Room*
5:30 p.m.–7:00 p.m.	Poster Session & Reception (*authors present*) ***(sponsored by OSTARA – Crystal Green)***	*Hall of the Doges*
7:00 p.m.	Dinner on your own	

TUESDAY, July 29, 2014

6:30 a.m.–7:45 a.m.	Production & Ext. Section Breakfast Meeting *(breakfast in meeting room)*	*The Early Bird Room*
6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast ***(sponsored by Evergreen Implement)***	*Marie Antoinette & Flowerfield Room*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*

	CONCURRENT SESSIONS: Industry-Based Seminars ***(Industry Day sponsored by BASF)***	
8:00 a.m.–9:45 a.m.	Extension Production & Management	*Grand Pennington A*
8:15 a.m.–9.45 a.m.	Breeding & Genetics/Marketing & Utilization	*Grand Pennington C*
8:30 a.m.–4:30 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*
9:45 a.m.–10:15 a.m.	***Break*** ***(sponsored by Ag World Support Systems, LLC)***	*Hall of the Doges*
	CONCURRENT SESSIONS (*continued*)	
10:15 a.m.–12:00 p.m.	Extension Production & Management	*Grand Pennington A*
10:15 a.m.–12:00 p.m.	Breeding & Genetics/Marketing & Utilization	*Grand Pennington C*
12:00 p.m.–1:30 p.m.	**Lunch** ***(sponsored by McCain Foods Inc.)***	*Marie Antoinette*
	CONCURRENT SESSIONS: Industry-Based Seminars	
1:30 p.m.–3:00 p.m.	Physiology/Extension, Production & Management	*Grand Pennington A*
1:30 p.m.–3:00 p.m.	Plant Protection	*Grand Pennington C*
3:00 p.m.–3:30 p.m.	***Break*** ***(sponsored by Con Agra)***	*Hall of the Doges*
	CONCURRENT SESSIONS (*continued*)	
3:30 p.m.–5:15 p.m.	Physiology/Extension, Production & Management	*Grand Pennington A*
3:30 p.m.–5:15 p.m.	Plant Protection	*Grand Pennington C*
4:30 p.m.–6:00 p.m.	Graduate Student Awards Committee	*Cutter Room*
5:30 p.m.	Silent Auction concludes	*Grand Pennington B*
6:30 p.m.–9:00 p.m.	Reception, BBQ and Live Auction ***(sponsored by JR Simplot Co)***	*Roof Garden Terrace* *(Back up: Isabella Ballroom)*

WEDNESDAY, July 30, 2014 - TOURS Off-Site, listed below

6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast	*Marie Antoinette & Flowerfield Room*
7:00 a.m.–5:30 p.m.	Fly Fishing Tour *(lunch provided)*	*Meet in Lobby*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
9:00 a.m.–3:00 p.m.	Local Ag Tour *(lunch provided)*	*Meet in Lobby*
10:00 a.m.–4:00 p.m.	Coeur d'Alene, ID tour *(lunch on your own)*	*Meet in Lobby*

THURSDAY, July 31, 2014

6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast	*Marie Antoinette & Flowerfield Room*
7:00 a.m.–8:20 a.m.	USDA Germplasm Breakfast Meeting *(bring breakfast from buffet into meeting room)*	*Cutter Room*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
8:30 a.m.–12:00 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*
8:45 a.m.–10:00 a.m.	FINAL SESSION: Breeding and Genetics	*Grand Pennington C*
10:00 a.m.–10:30 a.m.	***Break*** ***(sponsored by The National Potato Council)***	*Hall of the Doges*
10:30 a.m.–11:45 a.m.	FINAL SESSION (*continued*)	*Grand Pennington C*
12:00 p.m.–1:30 p.m.	**Lunch** ***(sponsored by Mel Martin Consulting)***	*Marie Antoinette*
1:30 p.m.–4:00 p.m.	PAA Business Meeting	*Marie Antoinette*
6:00 p.m.–6:30 p.m.	PAA Awards Reception ***(sponsored by Washington State Seed Potato Commission)***	*Flowerfield Room and Mezzanine*
6:30 p.m.–9:00 p.m.	PAA Awards Banquet ***(sponsored by Washington State University Dept of Horticulture and the College of Agriculture, Human, & Natural Resource Sciences)***	*Marie Antoinette*

DELEGATE PROGRAM

SUNDAY MORNING, July 27, 2014

9:00 a.m.–12:00 p.m.	Finance & Endowment Fund Comm.	*Davenport Boardroom*
12:00 p.m.–6:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
1:00 p.m.–5:00 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*
6:30 p.m.–9:00 p.m.	President's Reception	*Grand Pennington*

MONDAY MORNING, July 28, 2014

6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast	*Marie Antoinette & Flowerfield Room*
7:00 a.m.–8:20 a.m.	Editorial Board Meeting *(breakfast in meeting room)*	*Worthy Room*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
8:30 a.m.–4:30 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*

OPENING SESSION *Grand Pennington AB*

Presiding: Dr. Nora Olsen, PAA President

8:15 a.m. **WELCOME**
Co-Chairs, Local Arrangements Committee
Mark Pavek, Dept. of Horticulture, Washington State University, Pullman, WA
Raina Spence, Washington State Potato Commission, Moses Lake, WA

Assoc. Dean and Director of WSU's Ag Research Center
Jim Moyer, College of Agricultural, Human & Natural Resource Sciences, Washington State University, Pullman, WA

UTILIZATION AND MARKETING SYMPOSIUM 2014
Bringing New Potato Varieties to Market
Moderator: Dr. Joseph F. Guenthner, Department of Agricultural Economics and Rural Sociology, University of Idaho, Moscow, ID

8:45 a.m. **(S1) Symposium Introduction.**
Guenthner, JF. Department of Agricultural Economics and Rural Sociology, University of Idaho, Moscow, ID, USA.

9:00 a.m. **(S2) Varietal Change in North America-Can We Overcome Declining Consumption?**
Bragg, Jeff. Vice President of Meijer North America, Inc., Idaho Falls, Idaho, 83402, USA.

9:15 a.m. **(S3) New Varieties for the Eastern North American Table Market.**
Gareau, RM. Québec Parmentier, Rivière-du-Loup, QC G5R 3Z3, Canada.

9:30 a.m. **(S4) Save the Potato. Feed the World.**
Santiago, Angela. CEO & Co-Founder The Little Potato Company Ltd. Edmonton, Alberta, Canada.

9:45 a.m. **(S5) Roasted Specialty Potato Products - Baby Bakers & Fingerling Potatoes.**
Nedrow, Bret. Idaho Regional Raw Procurement Manager, J.R. Simplot Company, Caldwell, ID.

10:00 a.m. **BREAK** *Hall of the Doges*

10:00 a.m.–5:30 p.m. **Poster Session Setup** *Hall of the Doges*

10:30 a.m. **(S6) Potato Variety Innovation in Snack Foods.**
Sawatzky, Kirby. Parkland Seed Potatoes Ltd., Edmonton, Alberta, Canada.

10:45 a.m. **(S7) Environmental Opportunities of a Potato that Increasingly Becomes a Globally Traded Product.**
Haverkort, AJ. Wageningen University and Research Center, Plant Research International, P.O. Box 616, 6700 AP Wageningen, The Netherlands.

11:00 a.m. **(S8) Sustainable Potato Production – A North American Potato Industry Collaboration.**
Leclerc, Yves. McCain Foods, Florenceville, New Brunswick, Canada.

11:15 a.m. **(S9) Evaluation and Marketing of Various Valley Potato Varieties with Biomedical Effects in Rat and Human Volunteers.**
Lim, HT and HS Choi. Department of Bio-health Technology, Center for the Korea Potato Genetic Resources, and Global Potato Network Inc., College of Biomedical Sciences, Kangwon National University, South Korea.

11:30 a.m. **(S10) Bringing Innate™ Potatoes to Market**
Bradley, Kerwin. Simplot Plant Sciences, Boise, ID.

11:45 a.m. **Symposium Wrap-up Discussion**

12:00 p.m. **Delegate's Luncheon** *Marie Antoinette*

12:00 p.m.–1:00 pm. Site Selection Committee Meeting *Cutter Room*

MONDAY AFTERNOON, July 28, 2014

Concurrent Session I: Plant Protection *Grand Pennington A*

Moderator: Dr. Alexzandra F. Murphy, OSU Hermiston Agric. R & E Ctr., Hermiston, OR

1:30 p.m. **(G1) Possible Management Alternatives for Verticillium Wilt: Seed Treatments, In-furrow Applications, and Foliar Sprays.**
Light, SE[1], LD Porter[2], DA Horneck[1], and PB Hamm[1]. [1]Oregon State University Hermiston, OR 97838 and [2]USDA-ARS, Prosser, WA 99350, USA.
(Frank L Haynes Graduate Student Research Competition)

1:45 p.m. **(G2) Impact of Seed Treatments on Senescence and Yield of Potatoes Grown from Seed Encrusted with *Verticillium dahliae*- and *Colletotrichum coccodes*-infested Soil.**
Wheeler, DL[1], Cummings, TF[1], Hamm, PB[2] and DA Johnson[1]. [1]Dept. of Plant Pathology, Washington State University, Pullman, WA 99164, USA; [2]Dept of Botany & Plant Pathology, Oregon State University, Hermiston OR 97838, USA.
(Frank L Haynes Graduate Student Research Competition)

2:00 p.m. **(G3) Field Evaluation of Potato Genotypes for Resistance to *Spongospora subterranean.***
Bittara, FG, NC Gudmestad, GA Secor, AL Thompson and DA Peterson. Departments of Plant Pathology and Plant Sciences, North Dakota State University, Fargo, ND 58102, USA. ***(Frank L Haynes Graduate Student Research Competition)***

2:15 p.m. **(G4) Using Geostatistics and Spatial Information to Study Soil Data from Michigan Potato Cropping Systems.**
Steere, L, N Rosenzweig and WW Kirk. Dept. of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.
(Frank L Haynes Graduate Student Research Competition)

2:30 p.m. **(G5) Liberibacter Transmission Efficiency among Potato Psyllid Haplotypes.**
Mustafa, T[1,2], VG Sengoda[1], KD Swisher[1], JE Munyaneza[1], D Horton[1], RS Zack[2]. [1]USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA, USA; [2]Department of Entomology, Washington State University, Pullman, WA, USA.
(Frank L Haynes Graduate Student Research Competition)

2:45 p.m. **BREAK** *Hall of the Doges*

3:15 p.m. **(G6) Genetic Diversity of the NE-11 Strain of *Potato Virus Y***
Quintero-Ferrer, A, KJ Evans, and AV Karasev. Department of PSES and Bioinformatics and Computational Biology Program, University of Idaho, Moscow, ID 83844, USA.
(Frank L Haynes Graduate Student Research Competition)

3:30 p.m. **(G7) Typing Strains of *Potato Virus Y* Circulating in the Pacific Northwest in Potato Seed Lot Trials, 2011 to 2013.**
Karasev, AV[1], PB Hamm[2], JE Eggers[2], and JL Crosslin[3]. [1]Dept. of PSES, University of Idaho, Moscow, ID 83844, USA; [2]Oregon State University, Hermiston, OR, USA; [3]USDA-ARS, Prosser, WA, USA.

3:45 p.m. **(G8) International Endeavors in Investigating *Potato Virus Y* Transmission.**
Murphy, AF[1], A Moreno[2], A Fereres[2] and SI Rondon[1]. [1]Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR, USA; [2]Instituto de Ciencias Agrarias, Consejo Superior de Investigaciones Científicas, Madrid, Spain.

4:00 p.m. **(G9) Host Plant Choice of Colorado Potato Beetle, *Leptinotarsa decemlineata*, and Variation in Defoliation and Yield Losses among Organically Grown Commercial Potato Varieties.**
Wenninger, EJ and N Olsen. Dept. of Plant, Soil & Entomological Sciences, University of Idaho, Kimberly Research & Extension Center, Kimberly, ID 83341, USA.

4:15 p.m. **Adjourn**

4:15 p.m.–5:30 p.m.	Breeding and Genetics Section Meeting & Sponsored Special Seminar: A.J. Haverkort, Wageningen University and Research Center	*Grand Pennington C*
4:30 p.m.–5:30 p.m.	Plant Protection Section Meeting	*Lincoln Room*
4:30 p.m.–5:30 p.m.	Physiology Section Meeting	*Porter Room*
4:30 p.m.–5:30 p.m.	Utilization and Marketing Section Meeting	*Grand Pennington A*
4:30 p.m.–6:00 p.m.	Graduate Student Awards Committee	*Cutter Room*
5:30 p.m.–7:00 p.m.	**POSTER SESSION & RECEPTION** (*authors present*)	*Hall of the Doges*

MONDAY AFTERNOON, July 28, 2014
Concurrent Session II: Breeding and Genetics *Grand Pennington C*
Moderator: Dr. Richard G. Novy, USDA-ARS, Aberdeen, ID

1:30 p.m. **(G10) Range, Stability and Broad-Sense Heritabilities of Total Anthocyanins, Total Carotenoids and Oxygen Radical Absorbance Capacities (ORAC) in Advanced Potato Germplasm.**
Brown, Charles[1], Kathleen Haynes[2], Brian Charlton[3], Solomon Yilma[4], Steven James[5], and Jeff Stark[6]. [1]USDA/ARS, Prosser, WA 99350; [2]USDA/ARS, Beltsville, MD 20705, USA; [3]KREC, Oregon State University, Klamath Falls, OR 97603, USA; [4]Crop Science, Oregon State University, Corvallis, OR 97331, USA; [5]COARC, Oregon State University, Redmond, OR 97756, USA; [6]University of Idaho, Idaho Falls, ID 83402, USA.

1:45 p.m. **(G11) Genetic Linkage Mapping of Economically Important Traits in Cultivated Tetraploid Potato (*Solanum tuberosum* L.).**
Massa, Alicia N, Joseph J Coombs, Kimberly J Felcher, Daniel G Zarka, Norma C Manrique-Carpintero, William W Kirk, Anne E Lund and David S Douches. Michigan State University, Department of Plant, Soil and Microbial Sciences, East Lansing, MI 48824, USA.

2:00 p.m. **(G12) Population Structure and Genetic Differentiation of Potato Clones with Highly Informative SNP Markers.**
Bisognin, DA, A Massa, J Coombs and DS Douches. Dept. of Crop, Soil and Microbial Sciences, Michigan State University, East Lansing, MI, 48823, USA.

2:15 p.m. **(G13) TAL-Mediated Targeted DNA Integration in Potato Plants.**
Duan, Hui, Adrienne Forsyth, Troy Weeks and Craig Richael. Plant Sciences, J. R. Simplot Company, Boise ID 83706, USA.

2:30 p.m. **(G14) Genetic Analysis of Tolerance and Resistance to *Verticillium dahliae.***
Tai, Helen H[1], David De Koeyer[1], Claudia Goyer, Lana Nolan[1], Charlotte Davidson[1], Mads Sønderkær[2], Sanne Hedegaard[2], Kåre Lehmann Nielsen[2], Martin Lägue[1], Agnes Murphy[1], Pedro Uribe[3], and Dennis Halterman[3,4]. [1]Potato Research Centre, Agriculture and Agri-Food Canada, Fredericton, NB, Canada; [2]Department of Life Sciences, Aalborg University, Aalborg, Denmark; [3]Department of Plant Pathology, University of Wisconsin-Madison, Madison, Wisconsin, USA; [4]U.S. Department of Agriculture-Agricultural Research Service, Vegetable Crops Research Unit, Madison, Wisconsin, USA.

2:45 p.m. **BREAK** *Hall of the Doges*

3:15 p.m. **(G15) Solanum chacoense Rooting Response In Vitro.**
Christensen, CT[1], L Zotarelli[1], and K Haynes[2]. [1]Department of Horticultural Sciences, University of Florida, Gainesville, FL 32609, USA; [2]USDA-ARS, Beltsville, MD 20705, USA.

3:30 p.m. **(G16) Genomics Assisted Breeding: An Update on Oregon Potato Breeding and Variety Development.**
Sathuvalli, V[1,2], BA Charlton[1,3], S Yilma[1], and CC Shock[1,4]. [1]Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331, USA; [2]Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR 97838, USA; [3]Klamath Basin Research and Extension Center, Oregon State University, Klamath Falls, OR 97603, USA; [4]Malheur Experiment Station, Oregon State University, Ontario, OR 97914, USA.

3:45 p.m. **(G17) Breaking Physiological Dormancy in Tubers of Solanum chacoense.**
Christensen, C[1], L Zotarelli[1], K Haynes[2] and M Giurcanu[3]. [1]Dept. of Horticultural Sciences, University of Florida, Gainesville, FL, 32611, USA; [2]USDA-ARS, Beltsville, MD, USA; [3]Dept. of Statistics, University of Florida, Gainesville, USA.
(*Frank L Haynes Graduate Student Research Competition*)

4:00 p.m. **Adjourn**

4:15 p.m.-5:30 p.m. Breeding and Genetics Section Meeting & Sponsored Special Seminar

(G18) Durable Resistance to Late Blight in Potato through Cisgenic Modification after Eight years: Rationale, Results and Obstacles.
Haverkort, AJ. Wageningen University and Research Center, Plant Research International, P.O, Box 616, 6700 AP Wageningen, the Netherlands.

4:30 p.m.–5:30 p.m.	Plant Protection Section Meeting	*Lincoln Room*
4:30 p.m.–5:30 p.m.	Physiology Section Meeting	*Porter Room*
4:30 p.m.–5:30 p.m.	Utilization and Marketing Section Meeting	*Grand Pennington A*
4:30 p.m.–6:00 p.m.	Graduate Student Awards Committee	*Cutter Room*

POSTER SESSION & RECEPTION *Hall of the Doges*
5:30 p.m.–7:00 p.m.

Breeding and Genetics

(P1) Quantification of Acrylamide in Processed Potato Products by Near Infrared Spectroscopy (NIRS).
Adedipe, O[1], S Johanningsmeier[2], D Truong[2], D Douches[3], J Coombs[3] and C Yencho[1]. [1]Dept. of Hort. Sci., NC State Univ., Raleigh, NC; [2]USDA ARS Food Res. Unit, Dept. of Food, Bioprocessing & Nutrition Sci., NC State Univ., Raleigh, NC; [3]Dept. of Plant, Soil & Microbial Sci., Michigan State Univ., East Lansing, MI, USA.

(P2) Insights and Applications of the SolCAP Genome-Wide SNP Array.
Douches, David[1], C Robin Buell[2], Joseph Coombs[1], Norma C Manrique[1], Alicia Massa[1], Kim Felcher[1], Daniel Zarka[1]. [1]Dept. of Plant, Soil, and Microbial Sciences, Michigan State University, East Lansing, MI 48823, USA; [2]Dept. of Plant Biology, Michigan State University, East Lansing, MI 48823, USA.

(P3) Genotyping-by-sequencing of a Diploid Potato F2 Population.
Endelman, JB[1], and SH Jansky[1,2]. [1]Department of Horticulture, University of Wisconsin, Madison, WI 53706, USA; [2]USDA-ARS, Madison, WI 53706, USA.

(P4) Distorted segregation in Diploid Populations of Potato.
Manrique-Carpintero, Norma C[1], Joseph J Coombs1, Richard E Veilleux[2], C Robin Buell[1], and David S Douches[1]. [1]Michigan State University, East Lansing, MI 48824, USA; [2]Virginia Polytechnic and State University, VA 24061, USA.

(P5) Development of Molecular Markers Linked to Columbia Root-knot Nematode Tuber Resistance.
Patel, GK, CR Brown, and V Sathuvalli. [1]Hermiston Agricultural Research and Extension Center, Oregon State University, OR 97838, USA; [2]USDA-ARS Vegetable and Forage Crops Research Unit, Prosser, WA 99350, USA.

(P6) Genome-Wide Association Study (GWAS) and Mapping of Late Blight and Potato Virus X Resistance Loci in Potato Using Genotyping-by-Sequencing.
Yilma, S[1], V Sathuvalli[1,2], E Karaagac[1], and MI Vales[1]. [1]Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331, USA; [2]Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR 97838, USA.

Extension, Production and Management

(P7) Aminopyralid, Clopyralid and Dicamba Soil Residues Injure Potato and Daughter Tubers.
Boydston, RA[1] and SS Seefeldt[2]. [1]USDA-ARS, Prosser, WA, USA; and [2]University of Alaska, Fairbanks, AK, USA.

(P8) Regulatory Evaluation of Simplot Innate™ 2.0 Russet Burbank Potatoes.
Burzaco, Juan, Amy Ginter, Eric Rosenbaum, Pete Clark, Erika Roach, Matthew McDonald, Susan Collinge, Craig Richael, Kerwin Bradley, Haven Baker. Simplot Plant Sciences, 5369 W Irving Street, Boise, ID 83706, USA.

(P9) Effect of Variety and Previous Crop on Potato Yield in the Columbia Basin of Oregon.
Dung, JKS[1], GJ Harris[2], AB Haguewood[2], and PB Hamm[2]. [1]Central Oregon Agricultural Research Center, Oregon State University, Madras, OR, USA; and [2]Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR, USA.

(P10) Weed Control with Pyroxasulfone, Fomesafen, and Linuron in Pacific Northwest Potato.
Felix, J[1], RA Boydston[2], and P Hutchinson[3]. [1]Oregon State University, Ontario, OR, USA; [2]USDA-ARS, Prosser, WA, USA; and [3]University of Idaho, Aberdeen, ID, USA.

(P11) Season-long phosphorus availability using slow release Crystal Green®.
Froehlich, D and TL Naugler Klassen. Ostara Nutrient Recovery Technologies, Vancouver BC, V6E 2R1, Canada.

(P12) Tuber Yield and Acrylamide Concentration of Chips and Fries as Affected by Nitrogen Management, Cultivar, and Storage Time.
Sun N[1], C Rosen[1], J Crants[1], A Thompson[2] and M Glynn[3]. [1]Dept. of Soil, Water, and Climate, Univ. of Minn., [2]Dept. of Plant Sciences, North Dakota State Univ., [3]USDA-ARS Potato Research Worksite, East Grand Forks, MN, USA.

(P13) Low-Cost Potato Tissue Culture with Microwave and Bleach Media Preparation and Sanitation.
Weber, Brooke N, R Andrews Witherell, Amy O Charkowski. University of Wisconsin-Madison, Department of Plant Pathology, Madison, WI, USA.

Physiology

(P14) The Sprout Inhibitor 1,4-dimethylnaphthalene Alters the Expression of Genes in Potato Eyes Associated with Stress and Cell Viability.
Campbell, MA. Penn State Erie, School of Science, 4205 College Drive, P1 Prischak Bldg., Erie, PA 16563, USA.

(P15) Shrinkage and Bruising Characteristics of Seven Russet Potato Varieties during Cold Storage.
Goyer, A[1,2,3], V Sathuvalli[2,3,4]. [1]Dept. of Botany and Plant Pathology, Oregon State University, OR 97838, USA; [2]Hermiston Agricultural Research and Extension Center, Oregon State University, OR 97838, USA; [3]Center for Genome Research and Biocomputing, Oregon State University, OR 97331, USA; [4]Crop and Soil Science Dept., Oregon State University, OR 97838, USA.

(P16) A Model System that Elucidates the Mode of Action of α,β-unsaturated Carbonyl Compounds as Toxicants to Potato Sprout Tissue.
Knowles, LO and NR Knowles. Washington State University, Dept. of Horticulture, Pullman, WA 99164, USA.

(P17) Comparative Proteomic Analysis of Purple Pigmented and White Fleshed Sections in Tubers of Potato (*Solanum tuberosum* L.).
Külen, Oktay[1], Orhan Özcan[1], Ahmet T Baykal[2], Murat Çalar[3], David G Holm[4] and Cecil Stushnoff[5]. [1]TUBITAK MRC Genetic Engineering and Biotechnology Institute, Gebze, Kocaeli, Turkey; [2]Department of Medical Biochemistry, School of Medicine, Istanbul Medipol University, Unkapani, Istanbul, Turkey; [3]Department of Chemistry, Faculty of Arts and Sciences, GaziOsmanpaşa University, Tokat, Turkey; [4]San Luis Valley Research Center, Colorado State University, 0249 East County Road, 9N, Center, CO, USA; [5]Department of Horticulture & Landscape Architecture, Colorado State University, Fort Collins, CO, USA.

(P18) The Coordinate Induction of DNA Synthesis after Tuber Wounding.
Lulai, EC and JD Neubauer. USDA-ARS, Northern Crop Science Lab., Fargo, ND 58102, USA.

(P19) Phytonutrient Analysis of *Solanum sisymbriifolium* Berries.
Moehninsi[1,2], DA Navarre[2,3], and CR Brown[2,3]. [1]University of Idaho, Moscow, ID; [2,3]IAREC, Washington State University; [2,3]USDA-ARS, Prosser, Washington, USA.

(P20) Role of Sucrose and Transcription Factors in the Regulation of the Potato Phenylpropanoid Pathway.
Singh, RK,[1,2], R Payyavula[1,2], DA Navarre[2]. [1]Dept. of Horticulture, Washington State University, Pullman, WA, USA; [2]USDA-Agricultural Research Service, Prosser, WA 99350, USA.

Plant Protection

(P21) Tuber Symptoms Associated with Recombinant Strains of *Potato virus Y* in Specialty Potatoes under Western Washington Growing Conditions.
C Benedict[1], DA Inglis[2], D McMoran[3], and A Karasev[4]. [1]Washington State University Extension, Bellingham, WA 98225, USA; [2]Washington State University-Mount Vernon, WA 98273, USA; [3]Washington State University Extension, Burlington, WA 98233, USA; [4]Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID 83844, USA.

(P22) High-fidelity PCR Improves Detection of Zebra Chip (ZC) (*Candidatus* Liberibacter solanacearum) in Potato Tubers, Plants, and Potato Psyllids (*Bactericera cockerelli*) When Compared to a Conventional PCR Protocol.
Cating, RA, SI Rondon, and PB Hamm. Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR 97838, USA.

(P23) A Multiplex Reverse Transcription (RT) High-fidelity PCR Protocol for the Simultaneous Detection of Six Viruses that Cause Necrosis in Potato Tubers: *Alfalfa Mosaic Virus* (AMV), *Tobacco Rattle Virus* (TRV), *Tomato Spotted Wilt Virus* (TSWV) *Potato Mop Top Virus* (PMTV), *Potato Virus Y* (PVY), and *Potato Leafroll Virus* (PLRV).
Cating, RA, CN Sago, and PB Hamm. Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR 97838, USA.

(P24) *Wolbachia*-infection Differs Among Potato Psyllid Haplotypes.
Cooper, W[1], T Mustafa[1,2], K Swisher[1], S Garczynski[1], J Munyaneza[1], D Horton[1]. [1]USDA-ARS, Wapato, WA, USA; [2]Washington State University, Department of Entomology, Pullman, WA, USA.

(P25) Seed Treatments, In Furrow and Early Foliar Treatments for Control of Seed-borne *Phytophthora infestans.*
Dangi, Sandesh, William W Kirk, Paula Somohano, and Robert Schafer. Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

(P26) Comparison of Tuber Inoculation Techniques to *Phytophthora infestans.*
Dangi Sandesh, William W Kirk and Paula Somohano. Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

(P27) Susceptibility of Immature and Mature Potato Tubers to Different Genotypes of *Phytophthora infestans.*
Dangi Sandesh, William W Kirk and Paula Somohano. Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

(P28) Tolerance of Thirteen Potato Varieties to Three Herbicides.
Hutchinson, PJS, BR Beutler, C Miera, and B Kendall. University of Idaho, Aberdeen, ID 83210, USA.

(P29) Aphid Alert II Trapping Network: Monitoring Flights of Vectors of Potato Virus Y.
MacRae, Ian V and Nate Russart. Dept. of Entomology, University of Minnesota, Northwest Research & Outreach Center, Crookston, MN, 56716, USA.

(P30) Regional Variation of *Candidatus* Liberibacter solanacearum Genomic Sequences Isolated from Carrot Psyllids in Scandinavia.
McCue, K[1], GR Lazo[2], VG Sengoda[3], A Nissinen[4], L Sundheim[5], O Anderbrant[6], and JE Munyaneza[2]. [1]USDA-ARS, Albany, CA 94710, USA; [2]USDA-ARS, Wapato, WA 98951, USA; [3]MTT Agrifood Res. Finland, Jokioinen, Finland; [4]Norwegian Inst. for Agric. and Environ. Res., Aas, Norway; [5]Lund University, Lund, Sweden.

(P31) Baseline Sensitivity of *Fusarium* spp. Associated With Potato Dry Rot in Michigan to Fungicides.
Merlington, A and WW Kirk. Department of Plant, Soil and Microbial Science, Michigan State University, East Lansing, MI, 48824, USA.

(P32) Identification of *Fusarium* spp. Causing Dry Rot of Potato Tubers in Michigan's Commercial Potato Production.
Merlington, A and WW Kirk. Department of Plant, Soil and Microbial Science, Michigan State University, East Lansing, MI, 48824, USA.

(P33) Anastomosis Group, Pathogenicity and Fungicide Sensitivity of *Rhizoctonia solani* Isolates Collected in the Pacific Northwest.
Ricard, Darrah[1], Katie Fairchild[1], Emily Baergen[1], Philip B Hamm[2], Mark Pavek[3], and Phillip S Wharton[1]. [1]Department of Plant, Soil and Entomological Sciences, University of Idaho, Aberdeen Research and Extension Centre, Aberdeen ID, 83210, USA; [2]Oregon State University, Hermiston OR 97838, USA. [3]Washington State University, Pullman, WA 99164, USA.

(P34) In-furrow Fungicide Treatments for Control of Verticillium Wilt of Potatoes.
Steere, L, R Schafer, N Rosenzweig, K Polaskey and WW Kirk. Dept. of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

TUESDAY MORNING, July 29, 2014

6:30 a.m.-7:45 a.m.	Production & Ext. Section Breakfast Meeting *(Breakfast in meeting room)*	*The Early Bird Room*
6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast	*Marie Antoinette & Flowerfield Room*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
8:30 a.m.–4:30 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*

Concurrent Session I: Industry-based seminars
Extension Production & Management — *Grand Pennington A*
Moderator: Dr. Jeffrey C. Stark, Dept Plant, Soil & Entomol. Sci., Univ. of Idaho, Idaho Falls

8:00 a.m. **(G19) Nitrogen Rate Effects on Potato Yield, Quality and Acrylamide-forming Potential.**
Gause, Kathryn, Gregory Porter, L Brian Perkins, and Mary-Ellen Camire. University of Maine, Orono, Maine 04469, USA. ***(Frank L Haynes Graduate Student Research Competition)***

8:15 a.m. **(G20) The Influence of Agromanagement on Potato Mineral Nutrients.**
Kammlade, Sara M[1], DG Holm[2], SYC Essah[2], M Stromberger[3]. [1]Department of Horticulture & Landscape Architecture, Colorado State University, Fort Collins, CO 80523, USA; [2]San Luis Valley Research Center, Colorado State University, 0249 East Road 9 North, Center, CO 81125, USA; [3]Department of Soil and Crop Sciences, Colorado State University, Fort Collins, CO 80523, USA.
(Frank L Haynes Graduate Student Research Competition)

8:30 a.m. **(G21) Production Economics and Consumer Preference Reveal Alternatives to Russet Norkotah.**
Spear, RR, ZJ Holden, and MJ Pavek. Washington State University, Department of Horticulture, Pullman, WA 99164, USA. ***(Frank L Haynes Graduate Student Research Competition)***

8:45 a.m. **(G22) The Effects of Phosphorus Fertilizer on the Commercial Production and Postharvest Quality of Nine Potato Cultivars.**
Dolezal, C, ZJ Holden, NR Knowles, L Knowles, and MJ Pavek. Washington State University, Department of Horticulture, Pullman, WA 99164, USA.
(Frank L Haynes Graduate Student Research Competition)

9:00 a.m. **(G23) The Effects of In-Season Canopy Damage on Potato Growth, Development, and Grower Return.**
Shelton, SC, ZJ Holden, and MJ Pavek. Washington State University, Department of Horticulture, Pullman, WA 99164, USA. ***(Frank L Haynes Graduate Student Research Competition)***

9:15 a.m. **(G24) Nitrogen Modulates Physiological Maturity and Tuber N Content to Affect Postharvest Processing and Nutritional Qualities.**
Knowles, NR, MJ Pavek and LO Knowles. Washington State University, Department of Horticulture, Pullman, WA 99164, USA.

9:30 a.m. **(G25) Timing of Nitrogen Fertilizer Application for Increased N Use Efficiency in Potato Production of New Russets from Colorado State University.**
Essah, SYC and DG Holm. Department of Horticulture and Landscape Architecture, Colorado State University, San Luis Valley Res. Center, 0249 E Rd 9 N, Center, CO 81125, USA.

9:45 a.m. **BREAK** *Hall of the Doges*

10:15 a.m. **(G26) Potassium Rate Effects on Potato Yield, Quality and Acrylamide-Forming Potential.**
Gause, Kathryn, Gregory Porter, L Brian Perkins, and Mary-Ellen Camire. University of Maine, Orono, Maine 04469, USA.

10:30 a.m. **(G27) Detection of Nitrogen Deficiency in Potatoes Using Small Unmanned Aircraft Systems.**
Horneck, DA[2], ER Hunt, Jr[1], DJ Gadler[3], AE Bruce[3], RW Turner[3], CP Spinelli[3], JJ Brungardt[4], and PB Hamm[2]. [1]Hydrology and Remote Sensing Lab, Beltsville Ag Research Center; [2]Hermiston Ag Research and Extn Center, OSU; [3]Boeing Res & Tech, Kent, WA, USA; [4]Paradigm ISR, Bend, OR 97701, USA.

10:45 a.m. **(G28) Evaluating Sources of Aphid Vectors and *Potato Virus Y* in Eastern Oregon and Washington.**
Murphy, AF[1], R Cating[1], PB Hamm, J Crosslin[2] and SI Rondon[1]. [1]Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR, USA; [2]USDA-ARS, Vegetable and Forage Crops Research, Prosser, WA, USA.

11:00 a.m. **(G29) Potato Sustainability in Wisconsin: Results of an Industry-Wide Sustainability Assessment in 2013.**
Colquhoun, J[1], PD Mitchell[2], DL Knuteson[1], JA Wyman[1], N Willie2. [1]Department of Horticulture and [2]Department of Agriculture and Applied Economics, UW-Madison, Madison, WI 53706, USA.

11:15 a.m. **(G30) Evaluation of the Vital Farms PIP-200 System for Aeroponic Production of Seed Potato Mini-Tubers in Alberta.**
Konschuh, Michele. Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB T1R 1E6, Canada.

11:30 a.m. **(G31) Vietnamese Farmers Successfully Demystified Rapid Multiplication Technology to Revolutionize the Potato Industry.**
VanderZaag, P[1], PX Tung[2] and VU Nguyen[2]. [1]Sunrise Potato, Alliston, Ontario, L9R1V3, Canada; [2]Yersin University, Dalat, Vietnam.

11:45 a.m. **(G32) SCRI-Arylamide Agronomic Trials Identified Exceptional Clones with Low Acrylamide.**
Wang, Yi, Paul C Bethke, Alvin J Bussan. Department of Horticulture, University of Wisconsin-Madison, Madison, WI 53706, USA.

12:00 p.m. **Delegate's Luncheon** *Marie Antoinette*

TUESDAY MORNING, July 29, 2014

6:30 a.m.-7:45 a.m. Production & Ext. Section Breakfast Meeting *The Early Bird Room*
(Breakfast in meeting room)
6:30 a.m.–8:30 a.m. Buffet-Style Breakfast *Marie Antoinette & Flowerfield Room*

8:00 a.m.–5:00 p.m. Registration Desk/Visuals Viewing *Coat Check/Registration*

8:30 a.m.–4:30 p.m. PAA Executive Committee Meeting *Davenport Boardroom*

Concurrent Session II: Industry-based seminars
Breeding & Genetics/Marketing & Utilization *Grand Pennington C*
Moderator: Dr. Roy A. Navarre, USDA-ARS, Prosser, WA

8:15 a.m. **(G33) Potato Fingerprinting Using Genome-wide SNPs.**
Coombs, Joseph, Daniel Zarka, and David Douches. Department of Plant, Soil, and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

8:30 a.m. **(G34) National Chip Processing Trials: Four Years of Progress.**
Douches, David and Joseph Coombs. Department of Plant, Soil, and Microbial Sciences, Michigan State University, East Lansing, MI 48823, USA.

8:45 a.m. **(G35) Improving Potato Germplasm Collecting Technology.**
Bamberg, J, A del Rio and C Fernandez. US Potato Genebank, Sturgeon Bay, WI, USA.

9:00 a.m. **(G36) Crestone Russet and Mercury Russet: Two New Russet Potato Cultivars from the Colorado Potato Breeding and Selection Program.**
Gray, CP[1], DG Holm[1], SYC Essah[1], SS Jayanty[1], RD Davidson[2]. [1]San Luis Valley Research Center-CSU, 0249 East Road 9 North, Center, CO 81125, USA; [2]Department of Horticulture & Landscape Architecture, Colorado State University, Fort Collins, CO 80523, USA.

9:15 a.m. **(G37) Masquerade, Midnight Moon, and Red Luna: Three New Specialty Potato Cultivars from the Colorado Potato Breeding and Selection Program.**
Holm, David G[1], CP Gray[1], SYC Essah[1], SS Jayanty[1], RD Davidson[2]. [1]San Luis Valley Research Center-Colorado State University, 0249 East Road 9 North, Center, CO 81125, USA; [2]Department of Horticulture & Landscape Architecture, Colorado State University, Fort Collins, CO 80523, USA.

9:30 a.m. **(G38) Linkage Map and QTL Analysis for Internal Heat Necrosis in a Segregating Tetraploid Potato Population.**
Schumann, Mitchell[1], Craig Yencho[1], Mark Clough[1], and Kathleen Haynes[2].
[1]Department of Horticultural Science, North Carolina State University, Raleigh, NC 27607; [2]USDA ARS Plant Sciences Institute, Genetic Improvement of Fruits and Vegetables Laboratory, Beltsville, MD 20705, USA. ***(Frank L Haynes Graduate Student Research Competition)***

9:45 a.m. **Break** *Hall of the Doges*

10:15 a.m. **(G39) Generation of Herbicide-Resistant Lines of Potato Using Genome Editing.**
Butler, Nathaniel M[1], Nicholas J Baltes[2], Daniel Zarka[1], Colby G Starker[2], Daniel F Voytas[2], and David S Douches[1]. [1]Michigan State University, East Lansing, MI 48824, USA; [2]University of Minnesota, Minneapolis, MN 55455, USA.
(Frank L Haynes Graduate Student Research Competition)

10:30 a.m. **(G40) Purple and White Potatoes, even after Processing, Suppress Colonic Interleukin-6 Expression, a Pro-inflammatory Cytokine, in a High-fat Consuming Pig Model.**
A Sido[1], S Radhakrishan[1], E Eriksson[2], SW Kim[3], L Reddivari[1], and J Vanamala[1]. [1]Penn State University, PA, USA; [2]Lund University, Sweden; [3]North Carolina State University, NC, USA. ***(Frank L Haynes Graduate Student Research Competition)***

10:45 a.m. **(G41) Purple Potato, even after Processing, Suppresses Colon Cancer Stem Cell Growth *In Vitro* Independent of p53.**
Charepalli, V[1], R Vadde[3], L Reddivari[2], and J Vanamala[1]. [1]Food Science, [2]Plant Science, Penn State University, USA; [3]Biotechnology, Yogi Vemana University, India.
(Frank L Haynes Graduate Student Research Competition)

11:00 a.m. **(G42) Potatoes Can't Take the Heat: Effects of Cultivar and Processing on Global Metabolite/Nutritional Profiles.**
Markham, Laura[1], Lavanya Reddivari[2], Luke K Ursell[3], David Holm[4], Gregory Ziegler[1], Rob Knight[3], and Jairam Vanamala[1]. [1]Food Science, Pennsylvania State University; [2]Horticulture, Pennsylvania State University; [3]Chemistry and Biochemistry, University of Colorado at Boulder; [4]Colorado Agricultural Experiment Station, San Luis Valley Research Center, USA. ***(Frank L Haynes Graduate Student Research Competition)***

11:15 a.m. **(G43) The Growth in Potato Production and Inception of Secondary Potato Markets in India.**
Tyagi, Garima and Gina Greenway. Department of Agricultural Economics and Rural Sociology, University of Idaho, Moscow, ID 83844, USA.
(Frank L Haynes Graduate Student Research Competition)

11:30 a.m. **(G44) Economic Impact of Zebra Chip in Potato.**
Greenway, G and J Guenthner. University of Idaho, Moscow ID 83844, USA.

11:45 a.m. **(G45) Evaluation of Potato Anaerobic Digestate as a Renewable Alternative to Peat Moss in Horticultural Substrates.**
Vaughn, SF[1], E Lee[2] and RE Wagner[3]. [1]USDA/ARS, Peoria, IL 61604, USA; [2]Summit Seed, Inc., Manteno, IL 60950, USA; [3]Microbial Energy Systems, Inc., Bloomington, IN 47401, USA.

12:00 p.m. **Delegate's Luncheon** *Marie Antoinette*

TUESDAY AFTERNOON, July 29, 2014
Concurrent Session I: Industry-based seminars
Physiology/Extension, Production & Management *Grand Pennington A*
Moderator: Dr. Tim D. Waters, WSU Extension, Pasco, WA

1:30 p.m. **(G46) Sprout Inhibition by α,β-unsaturated Aliphatic Carbonyls – Discovery, Chemistry and Physiological Responses.**
Knowles, NR and LO Knowles. Washington State University, Dept. of Horticulture, Pullman, WA 99164, USA.

1:45 p.m. **(G47) Global Development and Commercial Launch of 3-decen-2-one (SmartBlock®) for Potato Sprout Control.**
Immaraju, J and T Zatylny. AMVAC Chemical Corporation, 4695 MacArthur Court, Suite 1200, Newport Beach, CA 92660, USA.

2:00 p.m. **(G48) Chloropropham Sprout Inhibitor Residue on Fresh-Pack Potatoes.**
Frazier, Mary Jo and Nora Olsen. University of Idaho, 3793N 3600E, Kimberly, ID 83341, USA.

2:15 p.m. **(G49) Miniaturization of Post-Harvest Sprout Control Chemical Application.**
Zalewski, Jim, Addie Waxman, Curtis Eames. 1,4GROUP, Meridian, Idaho 83642, USA.

2:30 p.m. **(G50) Biochemical Properties and Expression Analysis of Potato Cytokinin Oxidases during Tuber Dormancy.**
Suttle, Jeffrey C and Linda L Huckle. USDA-ARS Northern Crop Science Lab, 1307 18th St. N, Fargo, ND 58105, USA.

2:45 p.m. **(G51) Effect of Harvesting Time of Seed Tubers, Reconditioning and GA_3 Treatment on Dormancy Breaking of 'Superior' Potato Tubers.**
Jungseob, Moon, Hyonggwon, Chon, Yoonki Hong, Hoichun Lim, Jeongman Kim and Dongchil, Choi. Jeollabukdo Agricultural Research and Extension Services, Iksan 570-704, Korea.

3:00 p.m. **BREAK** *Hall of the Doges*

3:30 p.m. **(G52) Weight Loss in Storage: Russet Burbank and New Potato Cultivars.**
Brandt, Tina and Nora Olsen. University of Idaho, 3806N 3600E, Kimberly, ID 83341, USA.

3:45 p.m. **(G53) The Origin of Russet Burbank (Netted Gem), a Sport of Burbank.**
Bethke, Paul C[1] and Danielle J Donnelly[2]. [1]USDA ARS and Dept. Horticulture, University of Wisconsin, Madison, WI USA; [2]Plant Science Dept., McGill University, Ste. Anne de Bellevue, QC and Potato Research Centre, Agriculture and Agri-Food Canada, Fredericton, NB Canada.

4:00 p.m. **(G54) Vacuolar Invertase Gene Silencing in Potato Decreasing the Frequency of Sugar-end Defects.**
Zhu, X[1], C Richael[2], J Jiang[1], PC Bethke[1 3]. [1]Dept. Horticulture, University of Wisconsin, Madison, WI, USA; [2]Simplot Plant Sciences, J. R. Simplot Company, Boise, ID, USA; [3]USDA Vegetable Crops Research Unit, Madison, WI, USA.

4:15 p.m. **(G55) Effects of Simulated Glyphosate and Dicamba Drift in Seed Potatoes.**
Robinson, Andy[1] and Harlene Hatterman-Valenti[2]. [1]North Dakota State University and University of Minnesota, USA; [2]University of Minnesota, USA.

4:30 p.m. **(G56) Seed Size and Spacing on Profitability for Dry Matter Production in an Organic, Dryland System in Western Nebraska.**
Pavlista, Alexander D. University of Nebraska, Panhandle Research & Extension Ctr., 4502 Avenue I, Scottsbluff, NE 69361, USA.

4:30 p.m.–6:00 p.m. Graduate Student Awards Committee *Cutter Room*

4:45 p.m. **(G57) Analysis of the Regulation of Tuber Phytonutrient Metabolism.**
Payyavula, Raja[2], Rajesh Singh[2], and Roy Navarre[1,2]. [1]USDA-ARS, Prosser, Washington; [2]IAREC, Washington State University, Prosser, USA.

5:00 p.m. **(G58) Crystal Green® as a Slow Release Phosphorus Fertilizer Source for Potatoes.**
Froehlich, D and TL Naugler Klassen. Ostara Nutrient Recovery Technologies, Vancouver BC, V6E 2R1, Canada.

5:15 p.m. **Adjourn**

6:30 p.m.–9:00p.m. Reception, BBQ and Live Auction *Roof Garden Terrace*
(Back up: Isabella Ballroom)

TUESDAY AFTERNOON, July 29, 2014

Concurrent Session II: Industry-based seminars
Plant Protection *Grand Pennington C*
Moderator: Phil Hamm, Hermiston Agric. R & E Ctr., Oregon State University

1:30 p.m. **(G59) Resistance to Metalaxyl-m in Populations of the Potato Pink Rot Pathogen (*Phytophthora erythroseptica*) in Canada.**
Crane, B[1], RD Peters[1], LM Kawchuk[2], KI Al-Mughrabi[3], K MacDonald[1], A MacPhail[1], KA Drake[1], and D Gregory[1]. [1]AAFC, Charlottetown, PE, Canada; [2]AAFC, Lethbridge, AB, Canada; [3]NBDAAF, Wicklow, NB, Canada.

1:45 p.m. **(G60) Evidence of a Monogenic, Dominant Nature of the *Nz* Gene Conferring Resistance against *Potato Virus Y* Strain Z (PVY^{Z}) in Potato.**
Chikh-Ali, M[1], JS Rowley[1], JC Kuhl[1], SM Gray[2], and AV Karasev[1]. [1]Dept. of PSES, University of Idaho, Moscow, ID 83844, USA; [2]USDA-ARS, Cornell University, Ithaca, NY 14853, USA.

2:00 p.m. **(G61) A Multiplex IC-RT-PCR Assay Distinguishes Fourteen Strains and Recombinants of *Potato Virus Y.***
Chikh-Ali, M[1], SM Gray[2], and AV Karasev[1]. [1]Dept. of PSES, University of Idaho, Moscow, ID 83844, USA; [2]USDA-ARS, Cornell University, Ithaca, NY 14853, USA.

2:15 p.m. **(G62) Evaluating the Effectiveness of Pesticides in Controlling Potato Psyllids.**
Rondon, SI and E Echegaray. Oregon State University, Hermiston Agricultural Research and Extension Center, 2121 S First Street, Hermiston, OR 97838, USA.

2:30 p.m. **(G63) RNA-Seq Analysis of Early Infected Potato Leaves by Potato Virus Y in Resistant and Susceptible Potato Varieties.**
Goyer, A[1,2], L Hamlin[3], JM Crosslin[3], A Buchanan[1], JH Chang[1]. [1]Dept. of Botany and Plant Pathology, Oregon State University, OR 97838, USA; [2]Hermiston Agricultural Research and Extension Center, Oregon State University, OR 97838, USA; [3]USDA-ARS, WA 99350, USA.

2:45 p.m. **(G64) Silver Scurf Incidence and Severity at Four Storage Temperatures.**
Woodell, Lynn[1], N Olsen[1], and PB Hamm[2]. [1]University of Idaho, Kimberly, ID, 83341, USA; [2]Oregon State University, Hermiston, OR, 97838, USA.

3:00 p.m. **BREAK** *Hall of the Doges*

3:30 p.m. **(G65) Integrating Next-Generation Sequencing and GIS Technology to Develop Bacterial Diversity Baseline Data to Evaluate Soil Health in Michigan Commercial Potato Production Systems.**
Rosenzweig, N, L Steere, K Steinke, C Long, A Santa Maria, S Whitney, R Schafer and WW Kirk. Michigan State University, Department of Plant, Soil and Microbial Sciences, East Lansing, MI 48824-1325, USA.

3:45 p.m. **(G66) Fungicide Resistance of *Phytophthora infestans* (Mont.) de Bary, in Chapingo, México.**
Héctor Lozoya-Saldaña[1], Martha Nayeli Robledo Esqueda[2], and Jaime B Díaz de la Cruz[1]. [1]Departamento de Fitotecnia, Universidad Autónoma Chapingo, Chapingo, Estado de México, 56230, México; [2]Instituto de Fitosanidad, Colegio de Posgraduados, Montecillo, México.

4:00 p.m. **(G67) A Research Collection of Plant Pathogenic *Streptomyces*.**
Wanner, Leslie A. USDA-ARS Beltsville, MD, USA.

4:15 p.m. **(G68) Prevalence and Prevention of *Phytophthora infestans* US-23.**
Kawchuk, LM[1] ML Kalischuk[1], RD Peters[2], KI Al-Mughrabi[3], F Daayf[4], MW Harding[5] and RJ Howard[5]. [1]Agriculture and Agri-Food Canada, Lethbridge, AB T1J 4B1, [2]Agriculture and Agri-Food Canada, Charlottetown, PE C1A 4N6, [3]New Brunswick Department of Agriculture, Aquaculture and Fisheries, Wicklow, NB E7L 3S4, [4]University of Manitoba, Winnipeg, MB R3T 2N2, [5]Alberta Agriculture and Rural Development, Brooks, AB T1R 1E6, Canada.

4:30 p.m. **(G69) DuPont™ Zorvec™ ("DPX-QGU42", "oxathiapiprolin"): The First Member of a Novel Class of Oomycete Fungicides.**
Shepherd, CP. DuPont Crop Protection, Stine-Haskell Research Center, 1090 Elkton Road, Newark, Delaware, 19714-0030, USA and W.J. Summers, DuPont Crop Protection, 7070 Mississauga Road, Mississauga, Ontario, Canada.

4:30 p.m.–6:00 p.m. Graduate Student Awards Committee *Cutter Room*

4:45 p.m. **(G70) Monitoring Haplotypes of Potato Psyllid Collected from Potato and Bittersweet Nightshade in the Pacific Northwest.**
Swisher, KD[1], J. Munyaneza[1], and JM Crosslin[2]. [1]USDA-ARS, Wapato, WA 98951, USA; [2]USDA-ARS, Prosser, WA 99350, USA.

5:00 p.m. **(G71) Analysis of the Prevalence and Haplotypes of *Liberibacter solanacearum*, the Causal Agent of Zebra Chip Disease, in South-Central Idaho during the 2012 and 2013 Potato Growing Seasons.**
Dahan, J[1], B Thompson[1], EJ Wenninger[2], N Olsen[2], and AV Karasev[1]. Dept. of PSES, University of Idaho, [1]Moscow, ID 83844, USA; and [2]Kimberly, ID 83341, USA.

5:15 p.m. **Adjourn**

6:30 p.m.–8:30 p.m. Reception, BBQ and Live Auction *Roof Garden Terrace (back up: Isabella Ballroom)*

WEDNESDAY, July 30, 2014 - TOURS Off-Site, listed below

6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast	*Marie Antoinette & Flowerfield Room*
7:00 a.m.–5:30 p.m.	Fly Fishing Tour *(lunch provided)*	*Meet in Lobby*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
9:00 a.m.–3:00 p.m.	Local Ag Tour *(lunch provided)*	*Meet in Lobby*
10:00 a.m.–4:00 p.m.	Coeur d'Alene, ID tour *(lunch on your own)*	*Meet in Lobby*

THURSDAY MORNING, July 31, 2014

6:30 a.m.–8:30 a.m.	Buffet-Style Breakfast	*Marie Antoinette & Flowerfield Room*
7:00 a.m.–8:20 a.m.	USDA Germplasm Breakfast Meeting *(bring breakfast from buffet into meeting room)*	*Cutter Room*
8:00 a.m.–5:00 p.m.	Registration Desk/Visuals Viewing	*Coat Check/Registration*
8:30 a.m.–12:00 p.m.	PAA Executive Committee Meeting	*Davenport Boardroom*

Final Session:

Breeding and Genetics *Grand Pennington C*

Moderator: Dr. Charles R. Brown, USDA/ARS, Prosser, WA

8:45 a.m. **(G72) Identification of Disease Resistance Genes for Enhancement of Existing Potato Cultivars.**
Halterman, D. USDA Vegetable Crops Research Unit, Madison, WI, 53706, USA.

9:00 a.m. **(G73) Assessing *Potato Virus Y* Resistance in Advanced Breeding Lines and New Cultivars from U.S. Potato Breeding Programs.**
Whitworth, Jonathan L[1], Stewart M Gray[2], Russell L Groves[3], and Amy O Charkowski[3]. [1]USDA-ARS, Aberdeen, ID, USA; [2]USDA-ARS, Ithaca, NY, USA; [3]University of Wisconsin, Madison, WI, USA.

9:15 a.m. **(G74) Progress toward the Development of Recombinant Inbred Lines in Potato.**
Jansky, SH[1,2], DS Douches[3], and JB Endelman[2]. [1]USDA-ARS, Madison, WI, 53706, USA; [2]Department of Horticulture, University of Wisconsin-Madison, Madison, WI, 53706, USA; Department of Plant, Soil, and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

9:30 a.m. **(G75) Identifying Stable Common Scab Resistant Potato Clones: A Comparison of Evaluation in Standard Breeding Trials versus Dedicated Fields.**
Navarro, FM[1], KT Rak[2], E Banks[3], BD Bowen[1], C Higgins[4] and JP Palta[2]. [1]University of Wisconsin Agricultural Research Stations, and [2]Department of Horticulture, Madison WI 53706, USA; [3]OMAFRA-Guelph N1G 4Y2, Ontario; [4]Heartland Farms, Hancock WI 54943, USA.

9:45 a.m. **(G76) Development and Application of Genome-Wide Association Studies for Autotetraploid Potato.**
Rosyara, UR, and JB Endelman. Department of Horticulture, University of Wisconsin, Madison, WI 53706, USA.

10:00 a.m. **BREAK** *Hall of Doges*

10:30 a.m. **(G77) High Throughput Phenotyping Using an Unmanned Aerial Vehicle.**
Jansky, SH[1], DI Rouse[2], AJ Gevens[2], and FM Navarro[3]. [1]USDA-ARS and Department of Horticulture, University of Wisconsin-Madison, Madison, WI, 53706, USA; [2]Department of Plant Pathology, UW-Madison, Madison, WI, 53706, USA; [3]Wisconsin Agricultural Experiment Station, Hancock, WI, USA.

10:45 a.m. **(G78) Marker-Assisted Selection in Columbia Root-Knot Nematode and Potato Virus Y Resistance Breeding in Potato.**
Zhang, Linhai[1], Richard Quick[2], Charles R Brown[2]. [1]Irrigated Agriculture Research and Extension Center, Washington State University, Prosser, WA 99350, USA; [2]United States Department of Agriculture-Agricultural Research Service, Prosser, WA 99350, USA.

11:00 a.m. **(G79) Adoption of a Real-Time PCR-Based Strategy for the Quantification of *Verticillium dahliae* in Potato Stems for the Breeding of *Verticillium* Wilt Resistance at North Dakota State University.**
Sabba, Robert P[1], Asunta L Thompson[1], Julie S Pasche[2], Ray Taylor[2], and Neil C Gudmestad[2]. [1]Department of Plant Sciences, North Dakota State University, Fargo, ND 58108, USA; [2]Department of Plant Pathology, North Dakota State University, Fargo, ND 58108, USA.

11:15 a.m. **(G80) A02507-2LB and A03158-2TE: Promising Breeding Clones from the Northwest (Tri-State) Potato Variety Development Program.**
Novy, R[1], J Whitworth[1], J Stark[2], B Charlton[3], S Yilma[3], V Sathuvalli[3], NR Knowles[4], M Pavek[4], R Spear[4], T Brandt[2], N Olsen[2], M Thornton[2], C Brown[1], and J Debons[5]. [1]U.S. Dept. of Agriculture, [2]University of Idaho, [3]Oregon State University, [4]Washington State University, [5]PVMI, Bend, OR 97702, USA.

11:30 a.m. **(G81) Genetic Diversity and Evolution of Recombinants of *Potato Virus Y.***
Evans, KJ, and AV Karasev. Dept. of PSES and Bioinformatics and Computational Biology Program, University of Idaho, Moscow, ID 83844, USA.

11:45 a.m. **Adjourn**

12:00 p.m. **Delegate's Luncheon** *Marie Antoinette*

1:30 p.m.–4:00 p.m. PAA Business Meeting *Marie Antoinette*

6:00 p.m.–6:30 p.m. PAA Awards Reception *Flowerfield Room and Mezzanine*

6:30 p.m.–9:00 p.m. PAA Awards Banquet *Marie Antoinette*

ABSTRACTS

S2

Varietal Change in North America-Can We Overcome Declining Consumption?

Bragg, Jeff
Vice President of Meijer North America, Inc., Idaho Falls, Idaho, 83402, USA.

During the former century and into the new century, potato consumption has declined in developed countries. Many reasons can be given but many questions are being asked of the potato industry. The reasons include commoditization of stalwart varieties, potatoes demonized as a unhealthy vegetable, and many times a industry that thrived on cyclical behavior to drive prices or returns back to unsustainability. The easy way to look at the industry as a whole is to increase consumption and turn the tide so the entire industry rises. We should be looking at the radical changes in the industry since the turn of the century in 2000-When the world didn't collapse-just didn't eat more potatoes!

These opportunities include all of the following:
-Potatoes as a staple food for all people
-Potatoes as a gourmet food for the ages
-Potatoes produced sustainably, locally and throughout the continent
-Diversity of population and its affects on culture
-Potatoes as intellectual property and its affects
-Potatoes with different attributes to solve the nutrient deficiencies in humans
-Potatoes as "The Health Food for the Ages"
-Different potatoes for different dishes-maybe with those that pair well with Washington State Syrah's…

Lets look at where we were and where we are today. Will we increase consumption and save the industry and the world? Developing countries are finding potatoes as a way to feed the populace. This presentation hopes to illustrate the changing market forces that can be looking at North America.

S3

New Varieties for the Eastern North American Table Market

Gareau, RM
Québec Parmentier, Rivière-du-Loup, QC G5R 3Z3, Canada.

QUÉBEC PARMENTIER is a relatively new, vertically-integrated company composed of 30 grower-members involved with the production, packing and marketing of seed and table potatoes. As a result of establishing partnerships with public/private breeders, along with domestic and foreign companies, members gain access to new varieties which allow for differentiated products with greater added value to create demand in the marketplace. Consumer demand is rapidly evolving, both for our provincial market of 8 million and for our potential market of over 90 million that reside within a 24-hour delivery range. New cultivars with potential for the Eastern North American table market are currently undergoing evaluations. Test markets for russets, round whites, reds, yellows, creamers and fingerlings will be highlighted.

S4

Save the Potato. Feed the World

Santiago, Angela
The Little Potato Company Ltd., Edmonton, Alberta, Canada.

The CEO and Co-Founder of The Little Potato Company Ltd. will talk about the importance of the potato to feeding the world – plate by plate. The uniqueness of the potato is what consumers need and want. Instead of standing by and watching the potato decline in popularity and sales, we need to bring it back to its original glory, make it exciting, and part of what people want on their plate again. Angela Santiago will share how her and her father started The Little Potato Company Ltd. 17 years ago, and how consumer demands continuously shape their business and products. Innovations and trends that are fueling the business and the creamer potato business in general will be discussed, including breeding techniques, consumer trends, packaging design, and demographic shifts. The company has grown from its beginning stages, washing spuds in a bathtub and farmers market distribution, to over 50 million pounds sold. The Little Potato Company Ltd. holds the proprietary rights on all its varieties which are now sold through retailers and foodservice across Canada and the USA. Market demand has dictated plans for expansion both of fields and production facilities. With over 4,500 acres of small potatoes grown in regions such as Alberta, Saskatchewan, Manitoba, Nova Scotia, and PEI in Canada and California, Washington, Colorado, and Georgia in the USA and packing in Edmonton and PEI.

S5

Roasted Specialty Potato Products - Baby Bakers & Fingerling Potatoes

Bret Nedrow
Idaho Regional Raw Procurement Manager, J.R. Simplot Company, Caldwell, ID

Fresh consumption of Potatoes has been on the decline for the past 20 years. Consumers are using less fresh potatoes at home. This has occurred because of the increasing trend of eating away from home and more convenient easily prepared food at home. Concurrently, roasted vegetable products are on the increased. With that, there has been a demand for a roasted potato product. Simplot embarked on a marketing program with a new roasted potato product. Worked started in 2005 on developing a raw product program to support a small roasted potato product. To meet consumer demand and acceptance, it was determined that the roasted product needed to be sized to a specification of 26 – 38 MM. Several varieties were tested and evaluated for their yield potential and taste preference. The variety Bintje was eventually selected that met those parameters at a cost effective price. Commercial production began in 2006 on a small scale and has since grown to 1,000 acres of annual production. Following that program, an initiative on a roasted fingerling (color melody) was embarked in 2010. Both programs are continuing and showing stable market growth.

S6

Potato Variety Innovation in Snack Foods

Sawatzky, Kirby
Parkland Seed Potatoes Ltd., Edmonton, Alberta, Canada

The Snack Food industry has relied primarily on white fleshed potato varieties for processing their snacks in North America. New variety development has been slow to change to other colored fleshed varieties but with health concerns around acrylamides or carbohydrates there may be more opportunity for varieties that have desirable traits. Old Dutch Potato Chip Company has begun to use a yellow flesh, low sugar variety (Lady Claire), which was brought into Canada by Kirby Sawatzky and his company, Parkland Seed Potatoes Ltd. Perhaps with more diversity in variety development this change to new varieties will lead to more usage of potatoes throughout North America; increasing consumption in a declining market.

S7

Environmental Opportunities of a Potato that Increasingly Becomes a Globally Traded Product

Haverkort, AJ
Wageningen University and Research Center, Plant Research International
P.O, Box 616, 6700 AP Wageningen, The Netherlands

Where a few decades ago potato was mainly considered a local for local product, it increasingly becomes a globally traded commodity. Seed potatoes produced in North-Western Europe are not only traded to neighbouring countries within the European Union and the Middle East and North Africa but easily and by the thousands of tons to far away countries such as Cuba, Pakistan and Bangladesh. To produce chips (crisps) in countries where hardly potatoes are grown or at prohibitive prices producers such as in the Philippines ship in raw material from far away countries such as Canada and Germany. Frozen French fries are shipped from e.g. Belgium to Chile (via the Panama Canal) and even Australia. Apparently it is the most economical way. Success factors for exporting potato and its products are low cost production (long growing seasons and ample rainfall), economy of scale (high density of factories) and accessibility and closeness of production areas to seaports.

A reverse side of successful potato production and creating added value may be the over use of resources such as land, water, energy, minerals and emission of chemicals to the environment. Therefore we created world maps such as with potato areas (occupation of land), yields (land use efficiency), precipitation deficit (irrigation need), slopes (risk of erosion) and many more including nitrogen surplus and risk avoidance of late blight through increased number of sprays. These maps allow stakeholders in the global potato trade to take environmental issues into consideration as to assure that clients are served with products produced in most environmentally friendly way.

S8

Sustainable Potato Production – A North American Potato Industry Collaboration

Leclerc,Yves[1], Monte Anderson[2], Richard Burres[3], John Keeling[4], Joe Brennan[5], Tom Green[6], Ed Schneider[7], Dan Moss[8], Andy Dierks[9], Mike Wind[10]
[1]McCain Foods, Florenceville, New Brunswick, Canada; [2]J.R. Simplot Company, Caldwell, ID, USA; [3]ConAgraFoods, Kennewick, WA, USA; [4]National Potato Council, Washington, DC, USA; [5]Canadian Potato Council, Johnville, New Brunswick, Canada; [6]IPM Institute of North America, Madison, WI, USA; [7]Pasco, WA, USA; [8]Rupert, ID, USA: [9]Coloma, WI, USA; and [10]Taber, Alberta, Canada.

Responding to market place inquires for information regarding potato production practices; industry representatives joined together in 2010 and developed the Potato Integrated Pest Management (IPM) Survey. The web based survey allowed growers to once yearly answer a detailed series of questions about beneficial IPM practices on their farm. Each practice was categorized as *Basic*, *Steward*, *Expert*, or *Master*. By participating growers were able to benchmark their farm performance, practice by practice, to the average for their region, country or market segment. Individual data was secure, visible only to the grower or accessible by sharing to selected business partners. To reflect the broader themes of environmental stewardship, economic wellbeing and community support, industry representatives began to retool the survey in 2013 from the narrow focus on IPM to the more encompassing theme of sustainable potato production. Metrics have been added to measure nutrient efficiency, water usage, waste reduction and worker health and safety, with additional measures for pesticide and greenhouse gas usage under development. A consolidated set of survey questions and improved user functionality is scheduled for pilot across North America currently with survey roll-out scheduled for late 2014. Moving forward the survey will implement reviews by food companies in 2015 and third party auditing in 2016.

S9

Evaluation and Marketing of Various Valley Potato Varieties with Biomedical Effects in Rat and Human Volunteers

Lim, HT and HS Choi
Department of Bio-health technology, Center for the Korea Potato Genetic Resources, and Global Potato Network Inc, College of Biomedical Sciences, Kangwon National University, South Korea.

Several pharmacological activities of potato tubers and their constituents have been intensively studied using various color potatoes such as "Bora Valley", "Dasom Valley", "Gogu Valley, "Purple valley", and "Gui Valley", collectively termed "Valley potatoes". Upon oral administration to rats of ethanol and indomethacin-induced gastric ulcer model, raw potato juice of "Bora Valley with purple color" showed more or less anti-ulcerogenic activity than the starch, while "Superior" with white color showed marginal activity. The intake of "Dasom Valley" and "Bora valley" promoted the growth of *Bifidobacterium* and *Lactobacilus*, inhibited the growth of *C.perfringens* and *E. coli*, increased the fecal moisture content, and decreased the intestinal pH in human volunteers. Several peptide, PT-1 and others with heat-stable were isolated from "Gogu Valley" potatoes and found to be natural antibiotic and anti-cancer activities which can be used in human clinical trial as well as animal feeding. The addition of antibiotics in the diets resulted in the improved growth performance in feces and intestine. Potato peptide derived from "Gogu Valley" showed strong antibiotic effect on animal feeding. "Gui Valley" extract showed high effect on patients against high blood Pressure. These Valley potato varieties have been marketed in various ways such as TV home shopping and other traditional markets.

S10

Bringing Innate™ Potatoes to Market

Bradley, Kerwin
Simplot Plant Sciences, 5369 W Irving Street, Boise, ID 83706, USA.

Innate™ technology is a patented plant biotechnology process that works with a plant's own genes to enhance desirable traits and to decrease less desirable traits. Simplot's first application of Innate™ Technology includes the following traits: 1) reduced black spot bruising through PPO silencing; 2) reduced free asparagine levels. The first petition submitted to the USDA for regulatory review includes these traits in the following varieties: Russet Burbank, Ranger Russet, and Atlantic. Simplot anticipates that USDA approval will come in time for a limited commercial release for the 2014 crop in the fresh whole, fresh cut and chip markets. Market research reveals that consumers have favorable attitudes toward Innate™ potatoes. Economic benefits have been estimated along the marketing chain from grower to consumer. One benefit is less waste from potato bruising. Innate™ potatoes can help reduce the 3 billion pounds of fresh potatoes, valued at $1.4 billion that are lost at the consumer level each year.

G1

Possible Management Alternatives for Verticillium Wilt: Seed Treatments, In-Furrow Applications, and Foliar Sprays

Light, SE[1], LD Porter[2], DA Horneck[1], and PB Hamm[1]
[1]Oregon State University Hermiston, OR 97838 and [2]USDA-ARS, Prosser, WA 99350, USA.

Verticillium dahliae (VD) is a persistent soil borne pathogen in potato production and causes early plant death. Yield can be dramatically reduced, and the pathogen can persist in soil for up to 18 years. Soil fumigation is standard grower practice for disease prevention and is expensive and highly regulated. Grower perception is that phosphorus (P) prevents early death of plants and reduces yield loss. In this research several chemical, mineral, and herbal alternatives for treatment including mefenoxam, spirotetramat, $CaCl_2$, several forms of P, and clove and garlic oils were tested to reduce plant mortality. These treatments were applied as seed treatments, in-furrow, or as post-emergence applications. One-row plots were used in a randomized complete block design under center pivot irrigation in Hermiston, OR. Field data from one growing season, as well as supplementary green house (GH) and laboratory data were collected. In-furrow applications of P significantly reduced VD levels in stem tissue in a GH trial but inhibited emergence and reduced yields in the field. Mefenoxam applied in-furrow appeared to have some efficacy against VD in the GH trial, although not significant at P=0.05. In the field trial, $CaCl_2$ applied at 10lb/A was the only product that significantly reduced VD in plant sap with potato yields being increased. Cinnamon, carvacrol, and thymol inhibited VD growth at high rates *in vitro*. VD infects plants at early growth stages, and these treatments may improve management and yields in infested soils. Experience learned in 2013 lead to modifications in the 2014 field trials.

G2

Impact of Seed Treatments on Senescence and Yield of Potatoes Grown from Seed Encrusted with *Verticillium dahliae*- and *Colletotrichum coccodes*-Infested Soil

Wheeler, DL[1], Cummings, TF[1], Hamm, PB[2] and DA Johnson[1]
[1]Dept. of Plant Pathology, Washington State University, Pullman, WA 99164, USA; [2]Dept of Botany & Plant Pathology, Oregon State University, Hermiston OR 97838, USA.

Soil adhering to the surface of potato tubers can be infested with inoculum of *Verticillium dahliae* (*Vd*) and *Colletotrichum coccodes* (*Cc*). The effect of eight seed treatments--water wash, Mancozeb, Topsin-M, Mertect, wash + Mertect, Banrot, removal of infested soil, and application of infested soil to seed--on area under the senescence progress curve (AUSPC), yield, and *Vd* and *Cc* stem incidence were tested using seed encrusted with infested soil. The AUSPC was less (P<0.05) in plants from seed where infested soil was removed than in non-treated controls. Yield from seed treated with Banrot, Mertect, wash + Mertect, or the non-treated controls was greater than in plants from seed where infested soil was removed. Additionally, reduced emergence was observed in plants from seed where infested soil was removed. Incidence of *Vd* in stems, as determined by isolation on semi-selective media, was less in plants from seed treated with Mancozeb, Topsin-M, Mertect, wash + Mertect, Banrot, or where infested soil was removed than in plants from seed where infested soil was applied. Incidence of *Cc* in stems was less in plants from seed treated with Topsin-M, Banrot or washed than in plants from seed where infested soil was applied or removed. Incidence of *Cc* in progeny tubers was less where infested soil was removed, seed washed or treated with Topsin-M than in tubers where infested soil was applied and the non-treated controls. These results suggest that senescence, yield and incidence of pathogens in stems can be reduced by seed treatment.

G3

Field Evaluation of Potato Genotypes for Resistance to *Spongospora subterranean*

Bittara, FG, NC Gudmestad, GA Secor, AL Thompson and DA Peterson
Departments of Plant Pathology and Plant Sciences, North Dakota State University, Fargo, ND 58102, USA.

The biotroph protozoan *Spongospora subterranea* causes powdery scab on tubers, gall formation on roots, and is the vector of the potato mop top virus. Lesions occurring on tubers decrease marketability, while root infection reduces nutrient uptake and water absorption. Tuber yield and size may also be affected by *S. subterranea* infection. Genetic resistance represents the most suitable and long term management strategy for the pathogen; however, resistance levels vary among potato genotypes and between root and tuber infections and needs to be evaluated. During 2011 and 2012, five field experiments were conducted on irrigated, naturally infested soils in Minnesota and North Dakota. Experiments consisted of three replications of five-hill plots arranged in a randomized complete block design. The reaction of 113 potato genotypes with varying skin types (market class), were evaluated for powdery scab and root gall formation. The incidence and severity on powdery scab on tubers were significant among genotypes ($P < 0.001$) and highly correlated ($r > 0.96$). Differences for disease intensity were observed among environments and genotypes. Russet-skinned cultivars were more resistant among the other skin types. The cultivars Dakota Trailblazer, Karu, Ranger Russet, Russet Norkotah and Dakota Russet (ND8829-3) ranked as highly resistant, whereas Shepody, Kennebec and Red LaSoda were highly susceptible to diseases on both tubers and roots. A significant correlation between root gall formation and powdery scab was observed ($r = 0.47$; $P < 0.001$) but exceptions were noted. Cultivar selection is highly recommended as a component of an integrated disease management plan for reducing powdery scab.

G4

Using Geostatistics and Spatial Information to Study Soil Data from Michigan Potato Cropping Systems

Steere, L, N Rosenzweig and WW Kirk
Dept. of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48824, USA.

In 2012, a team comprised of growers and university researchers was established to address the issue of declining yields and decreased tuber quality in Michigan potato (*Solanum tuberosum*) production. The goals of the research were: 1. To better understand soil-borne pathogen inoculum levels in potato fields; 2. To better understand the soil biology and quantify soil microbial diversity and 3. To make correlations between yield and soil biological factors. In addition to interactions among soil properties and microbial diversity, the research team incorporated the use of geostatistics and geographic information systems (GIS) to create predictive maps of diversity, soil pathogen populations and yield of entire fields from the sample points. Twenty soil sample points were collected from 26 fields prior to potato planting in 2013 and each sample point was assessed for soil characteristics, *Verticillium dahliae* colony forming units, and soil microbial diversity. At harvest, yield (t/ha) was evaluated within each sampling grid and tubers were assessed for incidence and severity of potato common scab (*Streptomyces scabies*). After all data were collected, each field was assessed individually for spatial continuity and variability of the sample points using geostatistical parameters. Information was then interpolated using various geostatistical mapping methods and, statistical correlations were made. The procedures and methods developed during this study will become a useful tool for understanding microbial interactions as well as visualizing pathogen levels as part of an integrated pest management system.

G5

Liberibacter Transmission Efficiency among Potato Psyllid Haplotypes

Mustafa, T[1,2], VG Sengoda[1], KD Swisher[1], JE Munyaneza[1], D Horton[1], RS Zack[2]
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Zebra chip (ZC), a new and economically important disease of potato associated with the recently discovered bacterium "*Candidatus* Liberibacter solanacearum" (Lso) transmitted by potato psyllid, *Bactericera cockerelli*, is continuously threatening potato production in U.S., Mexico, Central America, and New Zealand. Occurrence of four different haplotypes of potato psyllid presents a challenge for management of ZC, especially in the Pacific Northwest of U.S., where all the haplotypes have been reported. It has been shown that Lso can effectively be transmitted to potato by its psyllid vector in a period as short as six hours. However, the actual minimal time required for potato psyllid to effectively transmit Lso resulting in ZC symptom development is unknown. Also, there has not been any study comparing vector transmission efficiency between the different psyllid haplotypes. Using the electrical penetration graph (EPG) technology, we determined vector efficiency of three psyllid haplotypes commonly found in the Pacific Northwest. Individual Lso-infected psyllids were given access to potato plants for 1, 2, 3, 4, 5, and 6 h and feeding behavior was recorded during each access period using EPG. Following each psyllid exposure, the plants were maintained in the greenhouse and observed for ZC symptoms. Lso infection in both psyllids and plants was confirmed by PCR. Results revealed that it take less than 3 minutes for the potato psyllid to effectively transmit Lso. No difference in vector transmission efficiency was observed between the psyllid haplotypes tested. Information from this research will help in the development of effective management strategies for ZC and its insect vector.

G6

Genetic Diversity of the NE-11 Strain of *Potato Virus Y*

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Strain NE-11 of *Potato virus Y* (PVY) was first reported in 2004 from Nebraska. In 2008, it was found recombinant, composed of three parental sequences, PVY^{N}, $PVY^{NA\text{-}N}$, and NE-11 proper. Later, NE-11 isolates were found in other states, and in 2012 an isolate of NE-11 was reported from tobacco in China. During 2012 Othello, WA, trials we collected two isolates of PVY classified as NE-11 using serological profiling and molecular typing by RT-PCR. The two isolates induced vein necrosis in tobacco. Both isolates were subjected to whole genome sequencing and subsequent recombination analysis. An interesting distinction from the original NE-11 isolate was found in the length of the segment coming from the $PVY^{NA\text{-}N}$ parent. Specifically, the two isolates from Othello had a shorter NA-N segment than the original NE-11, ca. 600 nt versus ca. 800 nt, respectively. Phylogenetic analysis of individual sections coming from different parental genomes confirmed the distinct evolutionary origin of the original NE-11, on one hand, and a group of NE-11 isolates collected later in Idaho and in Othello, on the other hand. Clade placement of the NE-11 isolates coming from different states suggested possible geographic origins of NE-11 isolates.

G7

Typing Strains of *Potato Virus Y* Circulating in the Pacific Northwest in Potato Seed Lot Trials, 2011 to 2013

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Potato virus Y (PVY) is a serious threat to seed potato production in the Pacific Northwestern (PNW) states of Idaho, Washington, and Oregon. PVY exists as a complex of strains which differ in symptom expression in different potato cultivars across diverse environments in the PNW. Recent spread of recombinant strains of PVY associated with tuber necrotic ringspot disease (PTNRD) is of particular concern. During three potato-growing seasons, 2011 to 2013, strain composition of PVY isolates circulating in PNW was determined from several hundreds of seed lots used in regional commercial plantings, using ELISA and RT-PCR typing. In Hermiston, OR, and Othello, WA, PVY-positive samples represented 82-89% of all plants with mosaic symptoms, indicating PVY as the main cause of mosaic symptoms. Between 2011 to 2013, more than three-fold drop in the proportion of PVY^{O} isolates circulating in the PNW potato was registered, from 63% of all PVY-positives to 17%. This drop in the PVY^{O} share was concomitant with the rise of the PVY^{N-Wi} recombinant incidence, from 27% of all PVY-positives to 49%. The proportion of the PVY^{NTN} strain, generally associated with PTNRD symptoms in susceptible cultivars, also increased, albeit modestly, to ca. 20%. An earlier survey (2001-2003) found a low incidence of recombinant PVY strains. PVY^{N-Wi} strain is not typically associated with PTNRD, however, more attention needs to be paid to these isolates of PVY, due to milder symptoms found in potato cultivars grown in the PNW. An increase in recombinant PVY incidence compared to the earlier survey suggests an increasing risk of PTNRD–associated PVY strains.

G8

International Endeavors in Investigating *Potato Virus Y* Transmission

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Potato virus Y (PVY) is a worldwide problem wherever potatoes or solanaceous crops are grown. PVY^{O} has been the dominant strain in the Pacific Northwest (PNW); however the strain known as 'N', mainly N-Wi, has recently become more predominant. In Spain PVY is a frequent problem in peppers and, in contrast to the PNW, PVY^{N} is the dominant strain. Both regions share several aphid vectors and weed species that are known alternative hosts for PVY. In an effort to better understand the shifts in PVY^{N} seen in the Pacific Northwest, a partnership was developed with European researchers to investigate PVY transmission and aphid preferences. Transmission of PVY^{N} between lambsquarters, *Chenopodium album,* and potatoes was investigated with two major vectors: *Myzus persicae* and *Macrosiphum euphorbiae*. Vector preferences for *C. album* were evaluated using assays where 200 *M. persicae* alates were allowed to settle on either infected or healthy plants. Settling was evaluated at 0.5, 2, 4, and 48 h for at least three replications and preferences were analyzed separately for each time period. Transmission rates from *C. album* to potatoes for *M. persicae* and *M. euphorbiae* were 44% and 37.5%, respectively. These are similar to the transmission rates reported between potatoes. Aphids were found to have no preference at 0.5, 2, and 4 h, but preferred healthy plants by 48 h ($t = 3.18$; df = 4; $P = 0.034$). This indicates that aphids may be unable to identify or avoid infected plants when migrating and may be choosing at random. However, as time progresses aphids may leave infected plants and move to healthy hosts, potentially increasing PVY transmission between weeds and potatoes.

G9

Host Plant Choice of Colorado Potato Beetle, *Leptinotarsa decemlineata*, and Variation in Defoliation and Yield Losses among Organically Grown Commercial Potato Varieties

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Colorado potato beetle (CPB) is one of the most important pests of potato in the U.S., and sustainable management tools—especially in organic production—are sorely needed. We conducted a two-year field study aimed at clarifying differences among commercial potato varieties in regard to preferences and defoliation rates of CPB and yield losses. We compared tuber yields and the abundance of different life stages of CPB over time among ten commercial potato varieties and two insecticide treatments (untreated and organic insecticide program). Yields were higher for insecticide-treated plots. High-yielding varieties included King Harry (bred for tolerance to CPB), Purple Viking, Yukon Gold, and Dark Red Norland. All Blue and Classic Russet tended to yield poorly. Initial "preferences" for certain varieties as adults colonized plots were not entirely consistent among weeks or between years. Egg abundance tended to reflect adult preferences, but shifted as females laid eggs on less infested plants. Differences among varieties in regard to larval abundance and defoliation rates were weak; however, certain varieties tended to show smaller differences in yield between insecticide-treated and untreated plots. For example, during 2012 both Dark Red Norland and Red Lasoda showed similar yields whether treated with insecticide or not, despite exhibiting significantly heavier defoliation when not treated. Other varieties (notably Classic Russet) showed 2-4 fold higher yields when treated with insecticides. These results suggest that variety selection—in conjunction with judicious use of insecticides—may be part of an IPM program for CPB management.

G10

Range, Stability and Broad-Sense Heritabilities of Total Anthocyanins, Total Carotenoids and Oxygen Radical Absorbance Capacities (ORAC) in Advanced Potato Germplasm

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A renewed interest in phytonutrients available from potato requires measurements in anthocyanins, carotenoids and antioxidants for variety evaluation. Little experience in the range of expression and stability of performance is available. We present here results of twenty one specialty breeding clones and varieties measured from tubers produced in six environments. Ranges, variance and variability of performance are presented. Estimates of broad-sense heritability provide predictions of response to selection. The high broad-sense heritabilities with narrow confidence intervals indicate high selection gain should be achievable for all traits. Remarkably large ranges of expression are found in all traits. High hydrophilic ORAC (HORAC) often accompanies high levels of total anthocyanins. Of great interest is that high HORAC also often accompanies very high carotenoid contents (dark yellow flesh), spanning a 13-fold range. These high HORACS are due to colorless phenolic acids. Genotypes and Genotypes x Locations are significant sources of variation for all traits. Relatively few clones show instability after removal of heterogeneity due to environment. Our main conclusion is that these four phytonutrient traits should be easily selected at high levels of expression and be stable over diverse environments.

G11

Genetic Linkage Mapping of Economically Important Traits in Cultivated Tetraploid Potato (*Solanum tuberosum* L.)

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We constructed a SNP-based genetic map at the cultivated tetraploid level to locate quantitative trait loci contributing economically important traits in potato. The 158 progeny and parents of a cross (MSL603) between Jacqueline Lee and MSG227-2 were SNP-genotyped using the Infinium 8303 potato array. 1663 simplex and duplex SNPs were segregating in the cross and 1056 simplex SNPs were used to construct a genetic map covering between 93-94% of the physical map with an average of 44 SNPs per chromosome. Furthermore, the progeny and parents were evaluated for foliar late blight reaction to the US8 genotype of *Phytophthora infestans*, tuber infection from common scab (*Streptomyces scabies*), tuber specific gravity, and vine maturity in replicated field studies. In 2001-3 MSL603 was screened for foliar resistance to the US-8 genotype of *P. infestans*, vine maturity, and specific gravity. While, in 2004 and 2005 MSL603 was screened for common scab. QTL analysis identified five SNPs present in Jacqueline Lee associated with a significant decrease in late blight infection, four SNPs associated with vine maturity QTL, one QTL linked with specific gravity, and one associated with scab. Three SNPs segregating in most significant QTL were associated with late blight resistance on the distal end of chromosome 9 within a R-gene hotspot. Between 2001-3 the QTL explained 44.8-68.4 of the phenotypic variation for foliar late blight resistance. The SNPs associated with tuber specific gravity, vine maturity, scab resistance, and late blight resistance can be used to develop marker-assisted selection breeding strategies.

G12

Population Structure and Genetic Differentiation of Potato Clones with Highly Informative SNP Markers

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With the advent of genome-wide analytical technologies, single nucleotide polymorphism (SNP) markers are increasingly favored as population genetic markers, because they are highly abundant and widespread in the genome. Numerous SNPs have been identified in potato and the SolCAP 8303 Infinum Array is available for genotyping. The objective was to identify an optimum set of most informative SNP markers to create a diagnostic panel that can effectively differentiate potato individuals and populations. In this study we use the tetraploid model (AAAA, AAAB, AABB, ABBB, BBBB) scores of 3,638 SNP markers of 205 potato varieties and breeding lines. Allele and the genotype frequencies were calculated for each SNP marker. There was a small variation for allele frequencies in the population similar to Hardy-Weinberg equilibrium. Potato varieties and advanced breeding lines with wild species in the pedigree were the most diverse based upon Kruskal's non-metric multidimensional scaling (NMDS). The identification of the most informative SNP markers was based on the *In* statistic values, because of the lower bias and mean square error. We created panels with an increasing numbers of most informative SNP markers and ran the NMDS. Each panel was compared to the original one based upon Spearman rank-order correlation analysis, with an empirical significant level of 1,000 permutations. The optimum number of SNP markers for the diagnostic panel was based upon the correlation values and the significance. The diagnostic panel with the optimum set of SNP markers reduces labor and genotyping cost for potato population structure and diversification studies.

G13

TAL-Mediated Targeted DNA Integration in Potato Plants

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Targeted DNA integration in plants would hypothetically provide a consistent and predictable transgene expression level. Line selection would be facilitated because genome position effects would be minimized. The deregulation of genetically modified events would be streamlined because the position of the DNA insert, and the flanking genomic regions, would be known. Here we describe a method combining TAL effector-mediated induction of double strand break and non-autonomous marker selection to insert a transgene into a pre-selected, transcriptionally active region in the potato genome. TALE was designed to create a double strand break in the genome sequence following an endogenous constitutive promoter. A promoter-less, plant-derived herbicide resistant gene was put close to T-DNA border and is used to select desired transgenic events. Consequently, gene of interest cassettes are inserted into a selected location at the site of the endogenous promoter. A cytokinin biosynthesis gene was used within the effector vector to allow selection against stable integration of TAL effector genes into the potato genome. Our results indicated that TALE can induce a high frequency of targeted integration. Single copy transgenic events resulting from targeted integration also showed more consistent expression of gene(s) of interest compared to single copy events resulted from random insertion.

G14

Genetic Analysis of Tolerance and Resistance to *Verticillium dahlia*

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Genetic variation in *V. dahliae* disease severity was found in two diploid potato clones, 07506-01 and 12120-03. 12120-03 had low levels of pathogen with infection and moderate symptoms indicating partial resistance. 07506-01 was infected with *V. dahliae* but did not develop symptoms, indicating tolerance to the pathogen. 12120-03 carried one *Ve2* resistant and one susceptible allele. The other diploid clone, 07506-01 was found to carry two susceptible alleles of the *Ve2* gene. Gene expression profiling leaves of infected plants showed that fungal defense genes, *Ve* resistance genes and ethylene, salicylic acid and jasmonic acid biosynthetic enzyme genes was decreased in 07506-01 compared to 12120-03 suggesting defense responses were suppressed in tolerance compared to resistance. Transcription factor gene expression differences pointed to the WRKY family as potential regulators of *V. dahliae* responses in potato. A diploid population generated from a cross between 12120-03 and 07506-01 was used to genetically map *V. dahliae* disease severity to a QTL located on chromosome 5. The disease severity QTL was at a similar location as QTL for maturity. Gene expression was also mapped as a quantitative trait (eQTL) using DeepSAGE.

G15

Solanum chacoense Rooting Response *In Vitro*

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Commercial potato varieties have a shallow rooting system that has proven to be problematic for nitrogen uptake efficiency, especially in production areas with sandy soils and heavy precipitation events. Recent tissue culture studies have looked at potato clone variation in root architecture, which could prove beneficial for determining such variations within wild *Solanum spp*. germplasm. The goal of this study was to investigate variations in root architecture in short-day adapted wild species *S. chacoense* germplasm, and compare it to 4x and 2x long-day adapted germplasm. Five commercial varieties ('Elkton', 'Harley Blackwell', 'Irish Cobbler', 'Kanona', 'NorValley'), 19 *S. chacoense,* and 37 *S. phureja x stenotomum* clones were grown in tissue culture in MS media with two different N treatments (100% and 50%). Three plantlets of each clone were grown at each N level. After four weeks growth, roots were scanned and analyzed using WinRHIZO software to estimate root length, root average diameter, root surface area, root volume, and the number of tips and forks. Significant differences ($p< 0.05$) were observed among species, and among clones within species for all root traits. *S. chacoense* produced roots that were longer than *S. tuberosum* or *S. phureja x S. stenotomum* (7.6 vs 4.1 vs 1.7 cm), with a greater diameter (0.79 vs 0.55 vs 0.25 cm), more surface area (2.34 vs 1.21 vs 0.21 cm^2) and volume (0.06 vs 0.03 vs <0.01 cm^3), and more tips (18 vs 10 vs 8) and forks (14 vs 4 vs 3). Within *S. chacoense,* genotypes from Argentina exhibited superior rooting overall. This information could allow for the development of new potato varieties with increased NUpE through the utilization of *S. chacoense* rooting traits.

G16

Genomics Assisted Breeding: An Update on Oregon Potato Breeding and Variety Development

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The Oregon Potato Breeding and Variety Development program plays a key role in the Tri-State (Idaho, Oregon and Washington) potato variety development program. Oregon breeding efforts focus on the four major market classes: 1) russets for processing, 2) fresh market russets, 3) chip stock, and 4) colored specialty varieties. Traits of importance include yield potential, biotic stress resistance, abiotic stress resistance (drought and heat stress, cold sweetening), cooking quality, low acrylamide level, bruise and shrinkage resistance, storability, internal quality and appearance, and phytonutrient content. Important biotic stresses include potato virus Y (PVY), verticillium wilt, Columbia root knot nematode (CRKN), soft rot, late blight, silver scurf, potato tuber worm, aphids, and psyllids. Our program uses molecular markers to identify segregating resistance progenies for PVY and CRKN resistance as part of marker assisted selections. Further, high throughput sequencing technology is being used to identify genomic regions associated with CRKN nematode and late blight resistance. Oregon potato breeding program effectively integrates various molecular, genomic and participatory breeding tools to develop varieties for various market classes.

G17

Breaking Physiological Dormancy in Tubers of *Solanum chacoense*

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Solanum chacoense (*chc)* is a wild species relative of *S. tuberosum* which has become a genetic resource for superior root biomass and nitrogen use efficiency. However, *chc* has shown difficulty breaking dormancy which may result in uneven emergence. The objective of this study was to determine an appropriate concentration of gibberellic acid (GA_3) and soak time to encourage sprout emergence in *chc.* Tubers of 11 genotypes of *S. chacoense* were separated by size (small, medium, and large) evenly across treatments. Treatments consisted of four concentrations of GA_3 (0, 50, 100, and 150 µg/ml) and three soak periods (5, 45, and 90 min). Once treated, tubers were kept in an incubator at 25 ºC under fluorescent lights for 24 h/day for 46 days. Proportion of sprouting was analyzed with a binary logistic regression model and sprout number with a linear model. GA_3 concentrations, genotypes, and tuber size showed significant differences ($p< 0.001$) for the proportion of sprouting events. GA_3 concentrations and genotypes exhibited significant differences ($p<0.05$) for sprout number. GA_3 concentrations of 50, 100 and 150 µg/ml exhibited a higher proportion of sprouting and number of sprouts ($p< 0.001$) than 0 µg/ml GA_3. There was also a direct correlation between tuber size and sprouting. Significant interactions were seen between GA_3 concentrations and genotype for both the proportion of sprouting events and sprout numbers. Significant interactions for genotype*tuber size and GA_3*soak time ($p< 0.001$) for sprout number were also exhibited. The 5 min soak of 50 µg/ml GA_3 proved to be the most effective at producing sprouts across all genotypes.

G18

Durable Resistance to Late Blight in Potato through Cisgenic Modification after Eight Years: Rationale, Results and Obstacles

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Annually worldwide a conservative estimate of 20 % of total attainable production of potato is lost due to late blight (costs of control and damage). In rich countries chemical control is under pressure as late blight pressure increases and there is societal resistance against the use of environmentally unfriendly chemicals. In resource poor countries chemicals are too expensive and often not available. Current breeding programmes have not been able to markedly increase the resistance levels of potato varieties. There are strong scientific investments needed to develop such improved varieties that may have great economic and environmental impact. Here we present an approach, based on (cisgenic) resistance genes that will enhance the impact. It consists of five issues/steps/themes: the detection of R-genes in the wild potato gene pool and their function related to the various aspects in the infection route and reproduction of the late blight causing pathogen; cloning of natural R-genes and transforming cassettes of single or multiple (cisgenic) R-genes into existing varieties with proven adaptation to improve their value for consumers; spatial and temporal resistance management research of late blight of the cisgenic GM varieties that contain different cassettes of R-genes to avoid breaking of resistance and reduce built up of epidemics; and communication and interaction with all relevant stakeholders in society and transparency in what research is doing. One of the main challenges being to explain the different nature and possible biological and legislative improvement of cisgenic GM crops in comparison to transgenic GM crops. Preliminary results are shown in this presentation.

P1

Quantification of Acrylamide in Processed Potato Products by Near Infrared Spectroscopy (NIRS)

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Development of lower acrylamide (AA) potato varieties for the potato processing industry requires rapid and accurate quantification methods to facilitate selection. This study focused on the development of NIRS as a screening tool for the prediction of AA concentration in French-fries and chips. For NIRS calibration in chips, samples of potato clones were selected from the national chip processor trial, and from a SolCAP mapping population. For the fries, russet potatoes processed with varying pretreatments and cook times were used for calibration development and validation. All chip and fry samples were analyzed for AA content using gas chromatography-mass spectrometry. Spectra data (400-2500 nm) were captured on a Foss XDS NIRS Analyzer. AA levels of potato chips and fries were correlated with NIR spectra regions to develop partial least squares models. Our results show that NIRS can be used for screening of potato samples for AA content. The best model for prediction of AA in fries (n=42, R^2 = 0.91) used the 700 - 2500 nm range. Prediction of AA in test samples (n=42) had a std. error of pred. (SEP) of 4.816 and RPD (Std. dev. /SEP) of 3.64. A single NIRS AA prediction model for fries and chips may be developed. The best mixed NIRS model (n=80, R^2 = 0.95) was developed with the 700 - 2500 nm spectra range. Prediction of AA in test samples (n=32) had a SEP of 5.23 and RPD of 3.3. This NIRS model for rapid and accurate prediction of AA could be used to accelerate the breeding and processing research.

P2

Insights and Applications of the SolCAP Genome-Wide SNP Array

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The Solanaceae Coordinated Agricultural Project (SolCAP) was supported by the USDA-NIFA from 2008-2014. Through innovative research, education and training, the SolCAP project focused on translating genomic advances to US tomato and potato breeding programs. A major impact from SolCAP has been the widespread use of the SolCAP 8303 Infinium Potato SNP Array as a common marker platform, with over 25,000 samples assayed by collaborators worldwide. The genome-wide SNP Array has provided a powerful new tool for potato breeders to evaluate potato clones and investigate genetic questions. Population structure and diversity analysis has been conducted on the diversity panel of 250 North American potato varieties and breeding lines. The diversity panel was also used to investigate allele frequency and heterozygosity in North American potato germplasm. At MSU, four tetraploid and three diploid mapping populations have been genotyped and phenotyped for economically important traits. The SNPs in these mapping populations have been useful in studying genetic phenomena including distorted segregation and double reduction. The SNP Array has been used to study 25 potato wild species from the core collection from the US Potato Genebank, as well as heterozygosity in selfing diploid *S. chacoense* species. Another application of the SNP Array is for fingerprint analysis, where tetraploid varieties and breeding lines are uniquely distinguished by over 1,000 SNP markers using tetraploid dosage, from a database of over 300 different potato clones (including closely related clones).

P3

Genotyping-by-sequencing of a Diploid Potato F2 Population

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Genotyping-by-sequencing, or GBS, is an attractive technology for genome-wide markers because of its low per-sample cost and lack of ascertainment bias. GBS is based on next-generation sequencing of a reduced representation of the genome, which is created by coupling a restriction enzyme digest with PCR to enrich the DNA library for small fragments. In addition, DNA barcodes are used to pool samples (e.g., 96, 384) for sequencing as a multiplexed library. To investigate the potential of GBS as a marker platform for potato, a diploid F2 population was created from the inbred lines DM (*S. tuberosum* Group Phureja) and M6 (*S. chacoense*) and genotyped at 96-plex at the Institute for Genomic Diversity (Cornell University). Single-end reads were truncated to 64 bp (after removing the DNA barcode) and aligned to version 4.03 of the DM reference genome. Using a threshold of $p > 10^{-5}$ for the expected 1:2:1 segregation ratio, just over 15,000 bi-allelic SNPs were identified with an average read depth of at least 10X per sample (which is sufficient to call diploid heterozygotes with 2% error). Large effect QTL for yellow flesh color and jelly end rot were identified on chromosomes 3 and 5, respectively. Based on the frequency distribution of the average read depth per sample, we conclude that GBS will be useful for genetic analysis and breeding in diploid and tetraploid potato.

P4

Distorted segregation in Diploid Populations of Potato

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Lethal zygote or gametophytic competition genes could underlie segregation distortion, observed as alterations of expected Mendelian genotypic frequencies in mapping populations. We observed highly dense SNP-based genetic maps to attempt to elucidate the genetic nature of distorted segregation in potato. Three intra and inter-specific diploid segregating populations (DRH, D84 and X902) were used. DRH and D84 are crosses between the sequenced double monoploid DM1-3 516 R44 *Solanum tuberosum* Group Phureja and either RH89-039-16 *S. tuberosum* or 84SD22 *S. tuberosum* × *S. chacoense* hybrid. X902 is an interspecific cross between 84SD22 and Ber83 *S. berthaultii* × 2x species mosaic. Genetic maps were generated in JoinMap4.1 for each population. Different alpha thresholds of chi-square test were used to detect distorted genotypic frequencies. At 5% level of significance, 23%, 57% and 51% of total SNPs mapped in DRH, D84 and X902 exhibited distorted segregation. Observed chromosome haplotype frequencies were plotted along genetic and physical positions to identify segregation distortion regions (SDR). For DRH the SDR were located on chromosomes 02, 09 and 12; for D84 on chromosomes 02, 03, 04, 06, 07 and 08; and on chromosome 02, 05, 06, 07, 09 and 12 for X902. Inter-specific crosses showed greater levels of distorted segregation. Similar location of SDR and direction of the distortion was found for some populations. However in general each population had particular SDR. The different genomic regions where the SDR occurred in the three populations likely reflect different causes for the distortion.

P5

Development of Molecular Markers Linked to Columbia Root-knot Nematode Tuber Resistance

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Columbia root-knot nematode (CRKN) caused by *Meloidogyne chitwoodi* Golden et al., is a major production constraint in potato (*Solanum tuberosum* L.). It is a serious pest in Columbia basin of Oregon and Washington where it attack on roots and tubers leading to loss in potato production and quality. Soil fumigation is the most effective means of controlling this disease. Because of the environmental concerns over the use of fumigants and high cost incurred in its application, host genetic resistance is viewed as a highly desirable alternative control method. Genetic resistance to CRKN was identified in a diploid wild species *S. bulbocastanum* Dunal (SB 22) and the resistance was successfully introgressed in to the domesticated tetraploid potato. Screening identifiedBC5 clone (PA99N82-4) to be root and tuber resistant to CRKN. The genes responsible for root ($RMc1_{(blb)}$) and tuber ($RMc_{(tuber)}$) resistance phenotypes were mapped to chromosome 11 and located 39 cM apart. Previous studies have identified molecular markers linked to root resistance. In this study a modified bulked Segregant analysis and high throughput sequencing based approach is being carried out to identify genomic regions associated with the tuber resistance. For bulked segregant analysis 6 tuber-resistant and 6 susceptible seedlings were used to create resistance and susceptible pools. The bulked segregants will be sequenced using Illumina HiSeq 2000. A bioinformatics pipe line is being developed to identify genomic regions associated with CRKN tuber resistance.

P6

Genome-Wide Association Study (GWAS) and Mapping of Late Blight and Potato Virus X Resistance Loci in Potato Using Genotyping-by-Sequencing

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The cultivated potato (*Solanum tuberosum* L.) is the world's most important vegetable crop grown in over 150 countries. Late blight, caused by *Phytophthora infestans*, and potato virus X (PVX) are two major diseases that affect world's potato production. Host genetic resistance is viewed as the most economical means of controlling these two pathogens. Clone LBR-8 (PI599265) is found to be resistant to both late blight and PVX. The objective of this study was to identify genomic regions and develop molecular markers linked to the resistance loci. A full-sib population of 152 seedlings from the cross LBR-8 × 'Ranger Russet' was screened for both late blight and PVX under artificial inoculations. Ninety three seedlings and the parents were genotyped by using Genotyping by Sequencing. Initial alignment and filtering generated 72,102 single nucleotide polymorphisms (SNPs). A linkage map and quantitative trait loci analysis will be performed to identify regions associated with these resistance loci. To further precise the location of resistance, genome wide association study (GWAS) will be carried using mixed linear model. The identified SNPs through linkage mapping and GWAS will be aligned with reference genome to identify potential candidate genes and also to develop breeder friendly genetic markers for use in marker assisted selections.

P7

Aminopyralid, Clopyralid and Dicamba Soil Residues Injure Potato and Daughter Tubers

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Aminopyralid, clopyralid and dicamba are used in Alaska to control certain invasive weed species, but may persist and injure potatoes in interior Alaska soils. Field studies at Delta Junction (DJ), Fairbanks (FB), and Palmer (PLM), AK were established to determine the above and below ground response of potato to soil-applied aminopyralid (0, 8, 15, 31, 62, and 123 g ae ha^{-1}), clopyralid and dicamba (0, 35, 70, 140, 280, and 560 g ae ha^{-1}). At DJ and FB, visual injury greater than 25% was observed at 15 g ae ha^{-1} aminopyralid, whereas at PLM injury was greater than 40% at 8 g ae ha^{-1}. At DJ and FB, 140 g ae ha^{-1} clopyralid injured foliage greater than 25%, whereas at PLM visual injury was greater than 25% at 70 g ae ha^{-1}. Dicamba foliar injury was greater than 25% at 140, 70, and 35 g ae ha^{-1} at DJ, FB and PLM, respectively. Aminopyralid at 15 g ae ha^{-1} or more reduced tuber production in DJ and PLM. Potato tuber production was reduced by clopyralid at 35 g ae ha^{-1} and 140 g ae ha^{-1} at DJ and PLM, respectively. At DJ, dicamba did not reduce potato tuber production, however at PLM, dicamba at 70 g ai ha^{-1} or greater reduced potato tuber production more than 50%. Aminopyralid concentration in daughter tubers increased with increasing field application rates, peaking at 30 ppb. All plants grown from daughter tubers collected from aminopyralid and clopyralid treated plots exhibited injury symptoms which increased with increasing herbicide rates. Dicamba at 140 g ae ha^{-1} or greater injured plants grown from daughter tubers and reduced shoot height. Efforts are underway to educate growers about potential carry-over injury and to determine rates of herbicide degradation in Alaska soils.

P8

Regulatory Evaluation of Simplot Innate™ 2.0 Russet Burbank Potatoes

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Innate™ is a patented biotechnology process that works with a plant's own genes to enhance desirable traits and to decrease less desirable traits. Simplot's Innate™ 2.0 lines include the following traits: 1) reduced incidence of black-spot; 2) reduced free asparagine levels; 3) lower reducing sugars; and 4) late blight resistance. Innate™ 2.0 technology has been incorporated into Russet Burbank, Ranger Russet, and Atlantic potato varieties. Multi-site field trials were conducted on Innate™ 2.0 lines in 2012 and 2013 in order to characterize plants and tubers and to assess environmental risk, plant pest potential, and agronomic performance. Additional studies evaluated tuber and fry composition, volunteer potential, and tuber dormancy. Trait efficacy and processing quality were evaluated at harvest and throughout storage. Trait specificity was evaluated through studies of susceptibility to foliar and tuber diseases other than late blight. A petition for deregulation was submitted in 2014 for Russet Burbank.

P9

Effect of Variety and Previous Crop on Potato Yield in the Columbia Basin of Oregon

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Nine years of data from a commercial potato farm were used to investigate the long-term effects of potato variety and previous crop on tuber yields in the Columbia Basin of Oregon. Total yields from 350 potato crops grown in172 production fields under potato rotations ranging from two to over five years between 2004 and 2012 were analyzed using ANOVA. Main effects included variety (Alturas, Russet Burbank, Premier Russet, Ranger Russet and Umatilla Russet) and previous crop (alfalfa, corn, mint, onion and wheat). Field location and year were random effects. A significant effect of variety (P<0.0001) on yield was observed, with Alturas (89.4±9.1 t ha^{-1}) and Premier Russet (87.4±6.7 t ha^{-1}) exhibiting significantly higher yields. Russet Burbank exhibited significantly lower yield (70.6±6.2 t ha^{-1}). The effect of previous crop was not significant (P=0.55) and a significant interaction with variety was not observed (P=0.09). The number of years cropped to potato or rotated out of potato did not significantly affect yield (P>0.78). Significant differences in yield were not observed (P>0.70) among fields with or without a cropping history of mint which, like potato, is a host of *Verticillium dahliae*. Although the effects of field location and year were significant (P≤0.01), potato yields were relatively stable overall (82.0±10.7 t ha^{-1}). These results suggest that factors such as variety, field location and annual growing conditions impact yield more than the immediate previous crop in high-input Columbia Basin potato production systems, where best management practices such as soil fumigation, crop rotation and IPM strategies are routinely applied.

P10

Weed Control with Pyroxasulfone, Fomesafen, and Linuron in Pacific Northwest Potato

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Managing weeds is important as they can reduce potato yield, impede harvest, and serve as alternative hosts for other pests. Studies were conducted in 2013 in Oregon, Washington, and Idaho to evaluate weed control with pyroxasulfone (149 g ai ha^{-1}), fomesafen (280 g ai ha^{-1}) and linuron (840 g ai ha-1) when tank-mixed with *S*-metolachlor, dimethenamid-p, metribuzin, or pendimethalin and applied preemergence to potatoes and weeds. Regardless of treatment and site, <5% potato injury was observed. Season-long control of common lambsquarters ranged from 88 to 99% across herbicide treatments and locations. Season-long control of *Amaranthus* species ranged from 83 to 100% at OR and 95 to 100% at ID. Season-long hairy nightshade control at OR, WA, and ID ranged from 64 to 98%, 83 to 100%, and >96%, respectively. In WA, Russian thistle was controlled the greatest (90 to 96%) with treatments that included metribuzin. In OR, control of kochia ranged from 84 to 100% for treatments that included fomesafen, pyroxasulfone, and/or metribuzin. Linuron tank-mixed with *S*-metolachlor or pendimethalin did not provide acceptable control of Russian thistle in WA or kochia in OR. Yield of U.S. No. 1 tubers reflected the level of weed control at each site. Fomesafen plus *S*-metolachlor resulted in the highest U.S. No. 1 yield (56.5 MT/ha) at OR. Mixtures containing fomesafen, pyroxasulfone and/or metribuzin provided U.S. No.1 yield ranging from 59.0 to 65.0 MT/ha at WA; while U.S. No.1 yield at ID ranged from 13.8 to 20 MT/ha across herbicide treatments. Herbicide combinations that include pyroxasulfone and fomesafen could provide broad spectrum, season-long weed control in the Pacific Northwest region.

P11

Season-long phosphorus availability using slow release Crystal Green®

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Phosphorus (P) is required by every living organism. Plants use phosphorus for energy transfer and storage, cell membranes, and reproduction. Up to 75% of the phosphorus fertilizer that is applied can become fixed in the soil, particularly at higher and lower soil pH levels. Movement of P into surface waters can cause eutrophication, a serious environmental concern. Traditional phosphorus fertilizers are highly water soluble, releasing over a relatively short period of time and thereafter being subject to soil fixation processes or environmental loss. This can result in yield-limiting reduced P availability later in the season, when potato uptake of P is critical for bulking. Crystal Green (CG) is a high purity, naturally slow release phosphorus fertilizer that is plant-available and "plant-activated". Release studies have shown that CG is still releasing late in the season, while also reducing the risk of environmental loss. Over two years, 19 potato trials have looked at the impact of using CG as a phosphorus fertilizer source. Providing either 50% or 25% of the P requirement from CG in combination with a traditional P fertilizer had benefits for P availability, as evidenced in the petiole P concentrations. The combination of upfront availability and slow release also impacted marketable yields and grade. In environmentally sensitive areas and in soils that have problems with P tie-up, Crystal Green can help provide plant available phosphate through the entire season.

P12

Tuber Yield and Acrylamide Concentration of Chips and Fries as Affected by Nitrogen Management, Cultivar, and Storage Time

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Decreasing acrylamide (ACRL) concentration in chips and fries has become a high priority in the potato industry. A field study was conducted in 2011 and 2012 at the Sand Plain Research Farm in Becker, MN to evaluate the effects of cultivar, nitrogen (N) rate and storage time on tuber yield and ACRL concentration in fried potato products. Three frying cultivars, Russet Burbank (RB), Alpine Russet (AR), and Dakota Trailblazer, (DT) and two chipping cultivars, Snowden (S) and Ivory Crisp (IC) were grown under five N fertilization regimes: 35, 135, 205, 270 or 335 kg N/ha. Whole-tuber ACRL concentration was determined at harvest and at 3, 6 and 9 months storage at 7.8^{o}C. Yield response to N rate was strongly affected by year, likely due to 26 more growing days in 2012. The N rate by cultivar interaction was not significant in either year for marketable yield. In 2011, yields ranked as follows: DT > S = IC > RB > AR. In 2012, yields ranked AR $\geq$ IC = DT = S $\geq$ RB (AR greater than RB) with marketable yields 3 to 18 t/ha greater in 2012 than in 2011. Optimal N rate ranged from 205 to 270 kg/ha in 2011 while in 2012 it ranged from 270 to 335 kg/ha or higher. The 3 newer cultivars had a higher percentage of yield over 168 g than RB or S. The relationship between ACRL concentration and N rate was inconsistent and depended on year, cultivar and storage time. In contrast, there were consistent differences among the cultivars each year. Overall, the new cultivars had lower ACRL concentrations than the older cultivars. Based on these results, cultivar selection has a more consistent effect on ACRL concentrations of fries and chips than N rate.

P13

Low-Cost Potato Tissue Culture with Microwave and Bleach Media Preparation and Sanitation

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Inexpensive methods need to be introduced into potato micropropagation to combat high costs. Sodium hypochlorite (NaClO) was examined as a low cost media and culture vessel sterilant. The introduction of 9 ppm (active chlorine) NaClO into media sterilized using an autoclave or microwave oven was found to control microbial growth, while not effecting plantlet performance. Non-sterile 16 oz. clear deli containers were selected as an inexpensive replacement for traditional culture vessels and can be effectively sterilized using a 50 ppm NaClO solution. Reuse of deli containers and altering the media water source decreased plantlet performance; yet can be implemented when micropropagation resources are limited. Replacing controlled growth chambers with a natural light environment presented a decrease in plantlet performance and an increase in microbial growth within culture vessels but may show promise with further refinement.

P14

The Sprout Inhibitor 1,4-dimethylnaphthalene Alters the Expression of Genes in Potato Eyes Associated with Stress and Cell Viability

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The environmental and health concerns associated with the sprout control agent (CIPC) have resulted in the development of new compounds for prolonging the storage of potato tubers. One such compound, dimethylnaphthalene (DMN), was originally isolated from potato skins and is used both in association with CPIC or alone to prevent sprouting in harvested tubers. In order to elucidate the mode of action for DMN RNA-seq was used to examine gene expression changes in non-dormant potato tubers (cv. Russet Burbank) treated with increasing amounts of this growth inhibitor. Potato tubers were treated in an airtight chamber with varying concentrations of DMN to yield skin residue levels of 0.15, 1.38, 2.13, and 4.2 ppm. Potato eyes were excised, frozen in liquid nitrogen, and stored at -80C. Total RNA was isolated from frozen meristems, quantified, and used to make cDNA. Samples were sequenced using Illumina technology and were mapped to the potato genome using the Tuxedo suite. Exposure of potato meristems to 2.13 ppm of DMN had reduction of transcripts associated with cell proliferation. At higher DMN exposures a number of WRKY transcription factors and other genes associated with cell stress and possibly apoptosis were induced.

P15

Shrinkage and Bruising Characteristics of Seven Russet Potato Varieties during Cold Storage

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Potato shrinkage and bruising are serious problems in the potato industry. Selection of potato genotypes with minimal shrinkage and lower susceptibility to bruising is currently inefficient and could be greatly improved by developing markers (biochemical and/or molecular) for marker-assisted selection. As a preamble to markers identification, seven russet potato varieties were evaluated for water loss, bruised area, bruise type, and bruise discoloration during 8 months in cold storage. Marked differences were observed between varieties. For instance, water loss was the lowest in 'Clearwater Russet' and the highest in 'Alturas'; bruised areas were much smaller in 'Umatilla Russet' and 'Alturas' than 'Premier Russet' and 'Clearwater Russet'; and bruise pigmentation was much less intense in 'Umatilla Russet' than in 'Premier Russet'. Our results show that genotype is a major determinant of shrinkage and/or bruising susceptibility, and suggest that there is room for genetic improvement for resistance to these two major issues.

P16

A Model System that Elucidates the Mode of Action of α,β-unsaturated Carbonyl Compounds as Toxicants to Potato Sprout Tissue

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α,β-Unsaturated carbonyl compounds have been shown to necrotize potato tuber sprouts when applied as vapors in sufficient concentration. Initial physiological responses of sprout tissue following exposure to vapors of 3-nonen-2-one (3N2) inform our understanding of the mode of action of these compounds as toxicants. Brief, sublethal doses of 3N2 were applied to internode sections of etiolated sprouts, which served as a model system to determine the metabolic bases for the ultimate necrosis observed when compounds of this chemical class are used as sprout inhibitors (e.g. SmartBlock®). The respiration rate of sprouts was depressed in a dose-dependent manner following 15, 30 and 45 min treatment with 3N2. During the initial 45 minutes of exposure, sprout tissue began to rapidly metabolize 3N2 to 2-nonanone and 2-nonanol, which can also be toxic to sprouts. 3N2 enhanced electrolyte leakage from sprouts following a 45 minute treatment, indicating structural damage to cell membranes, which led to desiccation and progressive browning of tissue. Total and reduced glutathione (GSH) decreased by 87% following a 45-min exposure, while a modest recovery of GSH and increase in oxidized glutathione were observed following a 2-h post treatment period in air. A related compound, 3-decen-2-one (a.i. in SmartBlock®), was the most effective of an array of 10-carbon aliphatic compounds in removing GSH from solution in an *in vitro* study. The initial rapid loss of GSH in sprout tissue treated with 3N2 may be due to the non-enzymatic formation of GSH-3N2 adducts. Loss of GSH disrupts redox potential and the ability of cells to modulate reactive oxygen species, leading to unabated oxidative stress and tissue necrosis.

P17

Comparative Proteomic Analysis of Purple Pigmented and White Fleshed Sections in Tubers of Potato (*Solanum tuberosum* L.)

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Potato anthocyanin flavonoids, are attractive for potential health benefits as antioxidants, and use in food, pharmaceutical, and nutraceutical industries. Tubers of CO97216-3P/PW, have both purple pigmented and white fleshed sectors within the same tuber, and thus provide a model to eliminate environmental effects on protein expression. Protein differences were detected by both gel free and gel based (Two-dimensional polyacrylamide gel electrophoresis), and were identified by proteomics using a high-definition mass spectrometer with a nano electrospray ionization source coupled to a high-performance liquid chromatography system (nanoUPLC−ESI−qTOF−MS). Comparison of purple pigmented and white sectors revealed 63 different gene products at the protein level. Twenty-four of the 63 proteins were patatins. Different copies within the patatin gene family were differentially expressed in both sectors. All of the differentially expressed patatins are inactive storage proteins and lack lipase activity. Twelve protease inhibitor proteins were differentially expressed. Alcohol dehydrogenase, catalase, monodehydroascorbate reductase and linoleate 9S lipoxygenase proteins, related to oxidative stress, were up regulated in the lower-antioxidant white fleshed sectors.

P18

The Coordinate Induction of DNA Synthesis after Tuber Wounding

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Tuber wounding induces a cascade of biological responses involved in processes required to heal and protect surviving plant tissues. Little is known about the coordination of these processes, including essential wound-induced DNA synthesis, yet they play critical roles in maintaining marketability of the harvested crop and tubers cut for seed. A modern "Click-iT EdU Assay" employing incorporation of the thymidine analog, 5-ethynyl-2'-deoxyuridine (EdU), in conjunction with 4',6-diamindino-2-phenylindole (DAPI) counter labeling, was employed to identify and determine the time course and spatial distribution of tuber nuclei that were wound-induced to enter S-phase of the cell cycle; a critical, but neglected part, of wound-healing. Both labeling procedures are rapid and sensitive *in situ*. Following wounding, EdU incorporation (indicating DNA synthesis) was not initiated until after 12 h, rapidly reached a maximum at about 18 h and then declined to near zero at 48 h. About 28 % of the nuclei were EdU labeled at 18 h reflecting the proportion of cells in S-phase of the cell cycle. During the 36 h in which induced cells were progressing through S-phase, *de novo* DNA synthesis extended 7 to 8 cell layers below the wound surface. Termination of nuclear DNA synthesis occurred about 4 d prior to completion of wound closing layer formation and initiation of wound periderm development; a time at which meristematic activity may be detected via the production of new phellem cells. Collectively, these results provide new insight into the coordination of cellular processes involved in tuber wound-healing.

P19

Phytonutrient Analysis of *Solanum sisymbriifolium* Berries

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Solanum sisymbriifolium (Litchi tomato) is a plant with edible berries, used as a trap crop in Europe for the management of the potato cyst nematode. Berries were collected from four Litchi tomato varieties grown in the field, and also grown separately in a greenhouse. Berries were examined for their antioxidant activity, total phenolics, seven phenolic acids, ascorbic acid, three carotenoids, three aromatic amino acids and soluble proteins. Litchi tomatoes were a good source of antioxidants (114.7-215 mM of Trolox equiv/g), phenolics (6.8-10.4 mg of gallic acid equiv/g), and ascorbic acid (2042-4511 µg/g). Phytonutrient content varied among the Litchi tomato varieties. Chlorogenic acid (1856-4385 µg/g) was the most abundant among seven quantified phenolic acids (chlorogenic acid, dihydrocaffeic acid, ferulic acid, caffeic acid, rutin, kaempferol, pelargonidin). Litchi tomatoes had generous amounts of Beta-carotene (707-1763 µg/g), which was most abundant carotenoid detected and responsible for the flesh coloration. Among the three quantified aromatic amino acids (tyrosine, phenylalanine, tryptophan), tyrosine (1087-2797 µg/g) was most abundant. Soluble proteins in litchi tomato ranged from 86.9-120.9 mg of BSA equiv/g. Compound concentrations differed between greenhouse and field grown samples. Of the litchi tomato varieties studied, SS91 had higher antioxidant activity, ascorbic acid, phenolic acids and carotenoids than other varieties. These results suggest that litchi tomato fruits serve as a good source of phytonutrients, could potentially be considered as a functional food and represent an added value to its use as a trap crop.

P20

Role of Sucrose and Transcription Factors in the Regulation of the Potato Phenylpropanoid Pathway

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Sugars (sucrose, glucose and fructose) play important roles as both nutrients and regulatory molecules throughout plant development. They are now known to function as signaling molecules and can control/regulate several metabolic pathways by induction or suppression of several genes and transcription factors. Relationship between sugars and their role in potato tuber phenylpropanoid metabolism was investigated. AN1 transcription factor plays an important role in potato phenylpropanoid metabolism and is induced by sucrose. Molecular characterization of *AN1* and its promoter in 20 genotypes of potato (with varied phenylpropanoid levels) suggested the promoter region may control *AN1* transcription levels in potato tubers. Promoters of AN1 from genotypes with high concentrations of phenylpropanoids showed the presence of multiple sucrose binding (SURE) elements. To further evaluate this sugar-phenylpropanoid interaction hypothesis, a comparative study of total sugars and total phenolics in 100 potato genotypes representing different colors, growth conditions, and developmental stages was conducted. Results suggested there is a positive correlation. Our results suggested that sucrose not only induces AN1 expression, but overexpression of AN1 induces sucrolytic genes, suggesting a possible feedback loop in controlling the carbon flux in phenylpropanoid metabolism. Sucrolytic genes such as *SUSY1*, *SUSY4*, *INV1* and *INV2* had multiple myb binding domains in their promoters, suggestive of a potential to be induced by AN1. These findings support a mechanism whereby sugars interact with transcription factors to regulate the phenylpropanoid pathway in tubers.

P21

Tuber Symptoms Associated with Recombinant Strains of *Potato virus Y* in Specialty Potatoes under Western Washington Growing Conditions

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Potato production in western Washington involves both seed and commercial operations uniquely interdependent since seed produced in one area often is utilized by commercial growers in another area. The region is defined by periods of heavy winter precipitation from September-April, and cool growing season temperatures, which lead to the predominance of specialty, short growing season (~80-90 days) cultivars. *Potato virus Y* (PVY) has emerged here as an increasing problem, however the strains associated with foliar and tuber symptoms that are distinctive to the specialty cultivars grown in the region have never been studied. In 2012 and 2013, a survey of seed and commercial fields (cvs. Chieftain and Yukon Gold) determined the incidence and strain composition of PVY in the region. Because of concerns about 'cracking' of progeny tubers, evaluations of tuber quality in four fields of plants expressing varying degrees of foliar symptoms were completed. Field surveys identified PVY^{N-Wi} (56.4%-2012 and 79.3%-2013) as the dominant strain across both years with incidence heavily clustered within a few fields. In one field, tuber quality evaluations revealed a significant reduction (63% and 99%) in marketable yield/plant in plants expressing either strong or mild symptoms, respectively. Others have reported a relationship between environmental conditions and expression of PVY symptoms in plants, and indicates the need to study this interaction in this unique production region.

P22

High-fidelity PCR Improves Detection of Zebra Chip (ZC) (*Candidatus* Liberibacter solanacearum) in Potato Tubers, Plants, and Potato Psyllids (*Bactericera cockerelli*) When Compared to a Conventional PCR Protocol

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The polymerase chain reaction (PCR) is an important tool in many areas of biology and is crucial for the detection and identification of many plant pathogens. High-fidelity PCR, which incorporates a proofreading enzyme into the reaction, has been shown to increase detection of target DNA over conventional PCR protocols while in the presence of inhibitors, large amounts of competitor DNA, or when the target DNA sequence is of limited quantity. *Candidatus* Liberibacter solanacearum (Lso), the organism that causes ZC, can be difficult to detect from potato tubers, plant tissue, and the vector, the potato psyllids (*Bactericera cockerelli* Sulc) due to PCR inhibitors such as competitor DNA (host genomic DNA) or other inhibitors present in the sample. In this study, high-fidelity PCR and conventional PCR protocols were performed on DNA samples from potato tubers, plants, and potato psyllids. The high-fidelity PCR protocol improved detection of ZC from tubers, leaves, and psyllids by 30-60% over conventional PCR. Our results indicate that high-fidelity PCR is more sensitive than conventional PCR when detecting the ZC pathogen from host tissue and significantly reduces false negatives obtained by conventional PCR. Since only a conventional PCR thermal cycler is required, no new equipment is required for high-fidelity PCR, making it an easy protocol for plant diagnostic clinics to adopt.

P23

A Multiplex Reverse Transcription (RT) High-fidelity PCR Protocol for the Simultaneous Detection of Six Viruses that Cause Necrosis in Potato Tubers: *Alfalfa Mosaic Virus* (AMV), *Tobacco Rattle Virus* (TRV), *Tomato Spotted Wilt Virus* (TSWV) *Potato Mop Top Virus* (PMTV), *Potato Virus Y* (PVY), and *Potato Leafroll Virus* (PLRV)

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Viruses that cause necrotic symptoms in potato tubers can be difficult to distinguish based on symptoms and frequently require multiple molecular tests to identify the pathogen. In this study, a multiplex RT PCR high fidelity PCR protocol was developed using previously validated primers that could quickly and accurately detect six important potato viruses as well as detect mixed infections. To test the protocol, fifty previously tested samples were retested using the multiplex protocol and blindly evaluated. In every case, the multiplex PCR results were consistent with previous findings. However, the multiplex PCR protocol also detected several mixed infections that were previously undetected. The results demonstrate that this technique could be a valuable assay for diagnostic laboratories and seed certification programs to enhance detection and lower costs by reducing personnel time and supplies required compared to individual virus testing. Additionally, because a conventional PCR thermal cycler is used for the assay, plant disease clinics and certification programs that already employ thermal cyclers can quickly, cheaply and easily adopt this technique.

P24

***Wolbachia*-infection Differs Among Potato Psyllid Haplotypes**

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Wolbachia is a bacterial symbiont of insects that can manipulate insect reproduction. In many insects, *Wolbachia*-free females cannot produce viable offspring when mated by infected males. The manipulation of insect reproduction by *Wolbachia* has implications for insect evolution and population dynamics. Diagnostic PCR using potato psyllids reared in colonies revealed that psyllids of the central and western haplotypes were both infected with two distinct strains of *Wolbachia*, but *Wolbachia* was not detected in psyllids of the northwestern haplotype. Consistent with *Wolbachia*-induced reproductive incompatibility, females of the northwestern haplotype did not produce viable eggs if mated by males of either the western or central haplotype. Screening psyllids of known haplotypes that were collected throughout the US from 2009 to 2014 confirmed that psyllids of the northwestern haplotype were *Wolbachia*-free while psyllids of the other two haplotypes were infected. All three haplotypes occur in the Pacific Northwest, but the northwestern haplotype predominates in this region. It is thought that the western and central haplotypes annually migrate to the Pacific Northwest from California and southern plains, respectively, while the northwestern haplotype is resident and overwinters in this region on nightshades. Our results suggest that gene flow among potato psyllid haplotypes is limited by respective differences in *Wolbachia* infection status. This knowledge will improve the interpretation of studies to assess interactions and biological differences among these psyllid haplotypes, which will then allow researchers to model psyllid population dynamics and to develop area-wide management strategies for the potato psyllid and zebra chip disease.

P25

Seed Treatments, In Furrow and Early Foliar Treatments for Control of Seed-borne *Phytophthora infestans*

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The efficacy of nine commercially available fungicides to manage seed-borne late blight was evaluated in controlled environment (CE) chambers and in the field. The number of emerged plants was recorded over a 6-week period after planting to estimate final plant stand (%) and the relative area under the emergence progress curve (RAUEPC). In the CE experiments, all treatments were significantly different from the inoculated check in both years at the final plant stand evaluation. Mandipropamid (single and double rates), flutolanil + mancozeb, fluodioxonil + mancozeb and mandipropamid + mancozeb were not significantly different from the non-inoculated check in terms of plant stand and RAUEPC. There were no significant differences among isolates of *P. infestans* on plant stand and RAUEPC in 2012 but in 2013 US-22 inoculated seed treatments had a lower plant stand relative to the other genotypes. All the treatments had lower disease incidence than the inoculated check. In the field experiment, all the treatments except the foliar application of mefenoxam + chlorothalonil had significantly greater plant stand and RAUEPC in comparison to the inoculated check. Responses of some treatments, relative to the non-inoculated non-treated check, indicated that some treatments enhanced emergence rate in 2012. The period between inoculation and seed piece treatment was increased in 2013, resulting in higher disease severity and lower plant stand compared to 2012. No treatments except mandipropamid + mancozeb (single and double rates), fluodioxonil + mancozeb and mancozeb were significantly different in plant stand and RAUEPC than the inoculated check in 2013.

P26

Comparison of Tuber Inoculation Techniques to *Phytophthora infestans*

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Potato tubers differ in susceptibility to *Phytophthora infestans* and different techniques have been used in various studies to determine the effect of different variables such as temperature and variety on the degree of susceptibility tubers have. The inoculation techniques involved 1) direct injection of a zoospore/sporangial suspension by syringe or micropipette into the flesh of the tuber; 2) the insertion of colonized agar plugs into wounded tubers; 3) placing inoculum-saturated filter paper onto the eyes of tubers; 4) spraying the tuber surface with a zoospore/sporangial suspension; and 5) direct immersion of tubers into a zoospore/sporangial suspension. The inoculation techniques 1) and 2) involved skin injury of the tubers and the other techniques involved no skin injury. Four genotypes of *P. infestans* (US-8, US-22, US-23 and US-24) and three cultivars of potato (Dark Red Norland, Russet Norkotah and Snowden) were tested. Result indicated direct injection of zoospore/sporangial suspension and use of colonized agar plugs caused significantly higher disease incidence and severity compared to all other inoculation techniques. Among the techniques with no skin injury, the immersion method produced consistent disease incidence and severity followed by inoculum-saturated filter paper technique. Spraying the tuber surface with a zoospore/sporangial suspension produced the least infection. Overall results indicated that the direct injection of zoospore/sporangial suspension and use of colonized agar plugs outperformed all other inoculation techniques; Russet Norkotah was the most susceptible cultivar and US-8 and US-22 were the most aggressive genotypes.

P27

Susceptibility of Immature and Mature Potato Tubers to Different Genotypes of *Phytophthora infestans*

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Potato tuber periderm is a significant morphological barrier that prevents infection by various pathogens. The importance of the tuber periderm to infection by *Phytophthora infestans* was determined. Three different cultivars of potato (Dark Red Norland, Russet Norkotah and Snowden) and four genotypes of *P. infestans* (US-8, US-22, US-23 and US-24) were used in the study. The tubers were immersed in the suspension of inoculum for 24 h to determine the susceptibility of potato tubers at different maturity stages. Periderm resistance to physical injury was determined using a skin set measuring device (Halderson Periderm shear tester). The device measured the amount of torsional force [mNm (milliNewton meters)] required to produce skinning injury. Result indicated that both immature and mature Russet Norkotah required higher torque (273.5 and 450.7 mNm in 2012 and 298.3 and 398.7 mNm 2013, respectively), than Dark Red Norland (223.3 and 304.1 mNm in 2012 and 212.0 and 296.1 in 2013 mNm, respectively and Snowden (208.0 and 316.4 mNm in 2012 and 235.5 and 299.5 mNm) in 2013, respectively. Russet Norkotah had thicker periderm and more phellem cells in the periderm than Dark Red Norland and Snowden. Immature cultivars were most susceptible to infection in both years. Immature Dark Red Norland and Russet Norkotah in 2012 and immature Dark Red Norland in 2013 were most susceptible to *P. infestans*. US-22 and US-8 were the most aggressive genotypes of *P. infestans*.

P28

Tolerance of Thirteen Potato Varieties to Three Herbicides

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In 2009 and 2010, recently-released potato varieties- Alpine, Classic, Highland, Premier, and Western Russet, and Yukon Gem; and standard varieties- Russet Burbank, Ranger Russet, Shepody, Yukon Gold, and Dark Red Norland were planted into 3-row plots at the Aberdeen R and E Center. In 2010, new releases Clearwater Russet and Huckleberry Gold were added to the trial. In 2011, both these varieties and only R. Burbank, Ranger Russet and Yukon Gem were tested. Each year, flumioxazin, dimethenamid-p, or fomesafen at 1X and 2X rates was applied preemergence to potatoes just after hilling and sprinkler-incorporated with 0.5 inch irrigation water within 24 hours. Nontreated variety-controls were included. Injury ratings and plant height measurements were recorded periodically. The trial areas were kept weed-free. Potatoes were harvested from the center-rows and graded. In 2009 and 2010, late spring/early summer weather conditions were unusually cold and wet and injury such as stunting was visible early-season. In general, flumioxazin 1X and 2X followed by dimethenamid-p 2X caused the most injury. Less vigorous emerging and slower early-season growing varieties, such as Russet Burbank or Premier Russet, were more affected than faster early-season growing varieties, such as Shepody. In 2009, flumioxazin caused stem and lower-leaf necrosis as a result of intense rainfall events splashing treated soil. In spite of injury any year, 1X rates did not cause U.S. No. 1 percent of total tuber yield reductions, regardless of herbicide or variety, while the 2X fomesafen rate resulted in some loss compared with nontreated control yields. Trial information was useful during 2009-2011 and after because growers were also experiencing injury on newly-released varieties which had never been tested for tolerance to these herbicides.

P29

Aphid Alert II Trapping Network: Monitoring Flights of Vectors of Potato Virus Y

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Aphid Alert II is a network of suction traps located throughout the seed potato production areas of Minnesota and North Dakota. Sixteen suction traps were emplaced next to potato field during the 2013 growing season (20-24 are planned for 2014). Clientele cooperators are recruited to host trap sites, with traps located on the margins of seed potato fields annually. Cooperators service and maintain the trap, replacing collection jars weekly and mailing them to the entomology laboratory at the UMN-Northwest Research & Outrteach Center. Entomology staff sort the weekly samples as they arrive, identifying aphid species, especially the PVY vector species. The aphid species composition and densities are reported weekly by location, results are posted to the web (http://aphidalert.blogspot.com/) and emailed to cooperators multiple times every week through the growing season. Traps are maintained until vines in the host field are killed or senesce. In 2013, a total of 2543 aphids representing 14 vector species were collected from June 21 through September 26. Aphid flight increased gradually throughout the beginning of the season then dramatically in August, peaking the week of August 23rd.

P30

Regional Variation of *Candidatus* Liberibacter solanacearum Genomic Sequences Isolated from Carrot Psyllids in Scandinavia

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New associations between *Candidatus* Liberibacter species and crop plants have been detected in different parts of the world, presenting concerns about the potential roles of these strains in causing disease. Plants infected with Liberibacter may experience significant yield losses and may also serve as potential reservoirs for Liberibacter to spread to other psyllid hosts with alternate crop feeding preferences, potentially introducing new epidemiological focal points among crops. Carrots showing damage from feeding of carrot psyllids (*Trioza apicalis*) were recently reported to also be infected with *Ca*. L. solanacearum (Lso), known to occur in association with psyllids and crops in the Solanaceae family and associated with Zebra Chip disease of potato. We analyzed genome sequences of psyllids from Finland, Norway and Sweden that showed the presence or absence of Lso. Using Illumina high-throughput short-sequence methods, we generated sequence libraries for all six psyllid samples. To assess the diversity of microbial sequences commonly associated with in psyllid microflora as well as to determine the extent of identity to Lso, we removed sequences from the dataset that were closely related to five other microbial reference genomes. Contigs with identity to the different bacterial genomes were assembled and differences between the putative Lso strain sequences were compared and identified. Differences between epidemiologically distinct strains may enable identification of infection sources and elucidate variation among regional populations.

P31

Baseline Sensitivity of *Fusarium* spp. Associated With Potato Dry Rot in Michigan to Fungicides

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At least 13 *Fusarium* spp. have been identified as causal agents responsible for potato dry rot in Michigan. Dry rot is managed by reducing tuber bruising, promoting rapid wound healing, and applying fungicides. The 11 *Fusarium* spp. recovered in this study (*F. oxysporum*, *F. incarnatum/equiseti*, *F. solani*, *F. sambucinum*, *F. proliferatum*, *F. acuminatum*, *F. sporotrichioides*, *F. avenaceum*, *F. redolens*, *F. graminearum*, and *F. crookwellense*) were screened for sensitivity to azoxystrobin, fludioxonil, difenoconazole, and thiabendazole (TBZ) (active ingredients of fungicides used for potato dry rot management). The effective fungicide concentration that caused 50% inhibition of mycelial growth (EC_{50}) compared to the control was determined using the spiral gradient dilution (SGD) method. The serial dilution plate (SDP) method was used to verify *Fusarium* isolates insensitive to difenoconazole. In 2011, all isolates of *Fusarium* spp. were sensitive to thiabendazole (EC_{50}<5 mg/L), except isolates of *F. sambucinum* and *F. solani* (EC_{50}> 5 mg/L), most isolates were sensitive to fludioxonil (EC_{50}< 100 mg/L) and difenoconazole (EC_{50}< 5 mg/L), and few were sensitive to azoxystrobin (EC_{50}< 10 mg/L). In 2012, all *Fusarium* spp. were sensitive to thiabendazole, except isolates of *F. sambucinum, F. solani*, and *F. oxysporum*. Most isolates of *Fusarium* were sensitive to fludioxonil, some were sensitive to azoxystrobin, and the majority were sensitive to difenoconazole, except for 8.3, 3.6, and 15.4% of the isolates of *F. incarnatum/equiseti*, *F. oxysporum F. solani*, respectively. Furthermore, four isolates grew on PDA containing 20 mg/L difenoconazole. Mixed resistance to the fungicides tested was also observed.

P32

Identification of *Fusarium* spp. Causing Dry Rot of Potato Tubers in Michigan's Commercial Potato Production

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A survey of potato tubers from Michigan (MI) commercial production storage facilities was carried out from 2011-2012 to determine the range of species responsible for dry rot. Isolates resembling *Fusarium* associated with tuber dry rot symptoms were identified to species, and pathogenicity and virulence were determined. Symptomatic tubers (n = 972) were collected from 32 commercial potato lots, from which 730 isolates of *Fusarium* spp. were recovered and identified to 11 species. *Fusarium oxysporum* was the most commonly isolated species (67.3%), followed by *F. equiseti* (13.6%), *F. solani* (5.8%), *F. sambucinum* (5.7%), *F. proliferatum* (3.2%) and *F. acuminatum* (1.9%). Less prevalent species present at ≤1% included *F. sporotrichioides*, *F. avenaceum*, *F. graminearum*, *F. crookwellense*, and *F. redolens*. Representative isolates of all species were pathogenic when inoculated onto potato tubers cvs. 'Snowden' and 'MSQ440-2' in 2011 and 'Atlantic' and 'Russet Norkotah' in 2012. Cultivars 'Snowden' and 'Atlantic' were significantly more susceptible based on percent area of infected tuber tissue. Isolates of *F. sambucinum*, *F. avenaceum*, and *F. acuminatum* were consistently the most aggressive, with minor differences in cultivar and year. Knowledge of the susceptibility of potato cultivars to dry rot and the *Fusarium* spp. present in commercial potato storage facilities is important.

P33

Anastomosis Group, Pathogenicity and Fungicide Sensitivity of *Rhizoctonia solani* Isolates Collected in the Pacific Northwest

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Rhizoctonia solani is an important pathogen of potato, causing both qualitative and quantitative losses. It has been associated with black scurf, elephant hide and stem canker. *Rhizoctonia solani* isolates are classified into several anastomosis groups (AGs), of which AG3 is most commonly associated with potato disease. Knowledge of the AG present is important as AGs can differ in aggressiveness to potato, host range, symptoms and fungicide sensitivity. Isolates of *R. solani* were collected from diseased potato tubers, plants and soil samples were collected from 7 different crops grown in rotation with potatoes throughout Pacific Northwest. The majority of isolates collected were identified as AG3 by qPCR, but sequencing confirmed that others were AG2-2IIIB, AG4 HG-II, AG5 and a binucleate Rhizoctonia species AG-A. Among the soil samples, oats had the highest percentage of *R. solani* AG3. Koch's postulates confirmed the pathogenicity of these atypical AG groups on potato in greenhouse studies. Fungicide sensitivity studies were also carried out to characterize the sensitivity of the isolates to fungicides commonly used to control Rhizoctonia diseases in the USA. Results showed that *in vitro* sensitivity to fungicides varied among AGs. Further results from this study could show the importance of AG screening, and could have implications on crop rotation and Rhizoctonia disease management practices in the USA.

P34

In-furrow Fungicide Treatments for Control of Verticillium Wilt of Potatoes

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A field trial was established at the Michigan State University Potato Research Farm (MRC), Entrican, MI to evaluate the efficacy of in-furrow fungicides for potato early die control. Potato seed ("Snowden") were planted on 16 May into two-row by 7.6m plots (~25.5cm between plants to give a target population of 60 plants at 0.86m row spacing) replicated four times in a randomized complete block design. Treatments included in the trial were difenoconazole, fludioxonil, azoxystrobin, flutolanil, pyraclostrobin, pyrimethanil + fluopyram, and PCNB. Oxamyl was applied with each treatment in-furrow (at planting), foliar at hilling and foliar three weeks after hilling. Percent emergence was calculated for each plot. Soil samples were taken from each plot at four times throughout the growing season (21, 50, 90, and 110 days after planting (DAP)). Samples were plated on *Verticillium dahliae* selective media and colony-forming units (CFU) were counted. Stem and tuber samples were taken from each plot 90 DAP, to assess visual symptoms of Verticillium wilt. Following visual assessment, plant sap was extruded and plated on selective media and CFU were quantified. Plots were harvested and yield (t/ha) recorded. Tubers were inspected for stem end vascular beading incidence. No treatments were significantly different from the control in percent emergence, stem symptom severity, stem sap CFU, yield, or tuber stem end vascular beading. For each treatment however, the number of CFU in the soil increased over time compared to the control. This observation has directed further research on the negative effect of the application of in-furrow fungicide treatments for the control of *V. dahliae* in the soil.

G19

Nitrogen Rate Effects on Potato Yield, Quality and Acrylamide-Forming Potential

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Nitrogen supply can have strong effects on yield and tuber quality. Nitrogen and other fertilizer nutrients can affect fresh tuber biochemistry, including dry matter content, reducing sugars, phenolics, and amino acids. These constituents can, in turn, can affect acrylamide formation in processed potato products. Adoption of new potato varieties bred for low acrylamide characteristics and careful nutrient management programs may help minimize the risk posed by acrylamide in processed potatoes. The objectives of this project were to explore whether reduced rates of nitrogen can help decrease the levels of acrylamide in fried potatoes while also maintaining yield, tuber size, and other attributes needed for processing. The standard variety, Russet Burbank, was compared to two promising new processing clones, AF3001-6 and AF3362-1. Three levels (0, 120, 240 lbs/A) of nitrogen fertilizer were applied at planting. Yield, tuber size, and specific gravity were determined at harvest. Tubers from 10ºC storage were tested for fry quality and analyzed for acrylamide precursors, such as asparagine and reducing sugars. A significant positive correlation was observed between reducing sugars, fry color, and acrylamide concentration. Nitrogen rate significantly affected tuber reducing sugars and acrylamide concentration; however, most of the difference observed was between the unfertilized versus fertilized treatments. Amino acid and phenolic concentrations were not strongly affected by nitrogen rate. AF3001-6 and AF3362-1 had significantly lower reducing sugars and acrylamide than R. Burbank.

G20

The Influence of Agromanagement on Potato Mineral Nutrients

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The purpose of this research was to study how agromanagement influences potato mineral nutrient density. Twenty-five clones from the Colorado Potato Breeding Program were grown at four farms ranging from conventionally managed monoculture rotations using synthetic fertilizers and pesticides to biologically managed polyculture rotations using organic amendments. Farms managed biologically had higher soil health metrics (e.g. microbial biomass, biological activity, and carbon pools) compared to farms managed conventionally. No trend was observed between agromanagement and mineral nutrient density. Detailed results on soil microbiology and specific mineral nutrient densities will be discussed.

G21

Production Economics and Consumer Preference Reveal Alternatives to Russet Norkotah

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Consumers have few options when purchasing fresh russet-type potatoes. Russet Norkotah (RN) dominates the fresh market due to lack of superior alternatives; however, recent research has identified suitable alternatives that exhibit excellent culinary quality and production economics. During 2011-13, RN was compared to six varieties, A01010-1, A03158-2TE, PA00N14-2, Classic R.., R. Burbank (RB), and Teton R. and four strains of RN, CO-3, CO-8, TX-278, and TX-296 for early- and late-harvest yield, economic value, bruise susceptibility, storability, and consumer acceptance (flavor, aroma, texture, aftertaste, and appearance) out of field and following 6 months of storage. RN had a significantly lower incidence of bruise than five entries (RB, A03158-2TE, PA00N14-2, AO00057-2, and Classic R.); RB produced the most blackspot bruise with 47% incidence. TX-296 had no incidence of blackspot bruise over the course of the study. A culinary evaluation by 600 panelists found that that PA00N14-2 and A03158-2TE had the greatest overall acceptance across three years. Following 6 months of storage, culinary quality did not appear to decline, or increase, among any of the cultivars. Several varieties and strains from both harvest dates produced higher economically viable yields than RN. Most noticeably, A03158-2TE in the early-harvest trial produced significantly higher yields than RN while all varieties produced higher economically viable yields in the late-harvest trial. Classic R. and Teton R. early yields produced 30% and 9% better economic return than RN, respectively; A01010-1 returned 38% more economic value than RN following the late harvest. Teton R. and A03158-2TE are viable early-harvest alternatives to RN and Classic R. and A03158-2TE are superior to RN when harvested late.

G22

The Effects of Phosphorus Fertilizer on the Commercial Production and Postharvest Quality of Nine Potato Cultivars

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Phosphorus (P) fertilizer is an important topic among WA legislators as they look to curb P levels in surface water. The industry must be proactive by demonstrating the importance of P to potato production while searching for P efficient cultivars. During 2011-13, nine cultivars, Russet Burbank (RB), Ranger R. (RR), Umatilla R. (UR), Alpine R.(AR), Alturas (ALT), Sage R.(SR), Teton R. (TE), Classic R. (CR), and Chieftain, were grown in P-deficient soil (<14 ppm P) with and without the addition of 227 lbs P2O5 fertilizer/A. RR, RB, and UR were also grown with 454 lbs P2O5/A. All cultivars were assessed for tuber number/plant, total and market yields, tuber size profile, internal quality, and economic return. The relationship of tuber P concentration and postharvest quality retention was also investigated on RB, RR, UR, AR, ALT, SR, and TE. When data were averaged across all cultivars (2011-13), P significantly increased total US 1 and >6 oz yield, gross return and tuber number/plant compared to the control. When cultivars were analyzed individually, all produced larger yields with the addition of P with the exception of TE and RR during 2012. Economic return for each cultivar increased with the addition of P, except RR in 2012. It proved economically feasible to apply 454 lbs P_2O_5/A pre-plant for RR, RB, and UR during 2012. The high rate of P boosted total yield between 20% and 68% for these varieties and increased gross return across all varieties. Postharvest analysis demonstrated that all cultivars treated with higher rates of P accumulated increased levels of tuber tissue P on a mg/g dry weight basis. Some varieties are less affected by lack of P than others, however, all nine varieties appear respond positively to P, when P is deficient.

G23

The Effects of In-Season Canopy Damage on Potato Growth, Development, and Grower Return

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Significant hail damage in Columbia Basin fields disrupted potato growth and reduced yields during 2012. The effects of defoliation during various plant growth stages in WA are poorly understood and crop-loss insurance values are unknown. To gain insight into these issues, simulated hail damage was applied to the canopies of one mid- and one late-maturing potato variety (Russet Norkotah TX278 (RN) and Ranger R. (RR)) during 2013 at four defoliation levels, 0%, 33%, 66%, and 99% and three potato growth stages, tuber initiation (TI), early tuber bulk (EB), and late tuber bulk (LB). There were substantial losses from ≥ 66% defoliation at all growth stages for both varieties but they were most severe at the EB stage and ranged from 25% to 88%. Grower return was not reduced by 33% defoliation at TI for either variety, but the higher levels of damage reduced grower return between 18% and 29%. When 99% of the canopy was removed at EB and LB, as much as 88% and 49% of grower revenue was lost. Plants damaged early in the season (TI) appeared to recover more than those damaged later; however, damage at the TI stage impacted tuber number per plant more than damage at the later growth stages. As defoliation increased from 0% to 99% at TI, tuber number per plant decreased from 8.0 to 5.4 for R. Norkotah and 7.2 to 5.2 for RR; apparently, the damaged plants redirected growth from tubers to canopy. RN's tuber number per plant was reduced slightly by severe defoliation at EB and LB; RR's tuber number was unaffected by damage occurring later than TI. The data suggest growers may not lose revenue from slight damage occurring early in the season; however, severe damage is costing the growers as much as $3,468/A for RN and $2,377/A for RR when it occurs during midseason (EB) growth.

G24

Nitrogen Modulates Physiological Maturity and Tuber N Content to Affect Postharvest Processing and Nutritional Qualities

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Foliar and tuber growth, tuber N and amino acid content of cvs Alpine and Sage Russet were modeled under four levels of N to determine N use efficiency, effects on physiological maturity (PM) and retention of process quality during storage. Increasing N from 213 to 507 kg ha^{-1} delayed the attainment of maximum foliar growth, increased foliar biomass and harvest index at maximum foliar growth, delayed vine senescence, and increased tuber yield for both cultivars. Yield increases were greatest for Sage (18%, +13.4 MT ha^{-1}) at 409 kg N ha^{-1} compared with Alpine (15%, +11.0 MT ha^{-1}) at 487 kg N ha^{-1}. More N thus resulted in more foliage (source) that persisted longer to enhance tuber yields. N use efficiency (yield/kg N) decreased with increasing N for both cultivars. Tuber N, protein and free amino acid concentrations also increased with N rate, thereby enhancing the nutritional value of tubers. Alpine was the most responsive; total tuber N increased 49% versus 33% in Sage. Asparagine accounted for ca 38% of free amino acids (by wt) and 18 (Alpine) to 23% (Sage) of the total N pool. Asparagine increased more rapidly during bulking of Sage than Alpine but the increases with N rate were greatest for Alpine. PM ranged from 137 to 153 DAP and was delayed with increasing N. Tubers grown at low N matured longer under dead vines and were therefore physiologically older at harvest than tubers grown with high N. Low-N tubers accumulated more RS, which compromised process (fry) quality sooner over a 250-d period of storage than tubers grown with high N. Nitrogen rate therefore affected retention of process quality and acrylamide forming potential by influencing tuber asparagine content and PM-dependent buildup in reducing sugar levels.

G25

Timing of Nitrogen Fertilizer Application for Increased N Use Efficiency in Potato Production of New Russets from Colorado State University

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Nitrogen (N) fertilizer application timing is one of the most important management techniques that potato growers can use to increase N Use Efficiency, and improve tuber yield and quality. Potato cultivars vary in their response to N fertilizer application timing. Field studies were conducted at the San Luis Valley Res. Center, CSU, to evaluate the response of an early and a medium maturity potato cultivars to N fertilizer application timing. N fertilizer application timing treatments included the application of i. 33% of the required N pre-plant; ii. 50% of the required N pre-plant; and iii. 66% of the required N pre-plant. A control treatment was established where no N was applied pre-plant, but all the required N was applied in-season. For the early maturity cv Mercury Russet, leaf area index (LAI) was highest (1.2) at 93 days after planting (DAP) when all required N was applied in-season or when 66% of the required N was applied pre-plant the LAI was 0.9. For the medium maturity cv Crestone Russet, LAI was observed to be highest (4.3) at 93 DAP when 33% or 50% of the required N was applied pre-plant. Total and marketable tuber yield for Mercury Russet was highest (395 and 230 cwt/A, respectively) when 66% and 50% of the required N was applied pre-plant, respectively. For Crestone Russet, total and marketable tuber yield was highest (468 and 397 cwt/A, respectively) when 33% of the required N was applied pre-plant. Data from these studies indicate that appropriate N fertilizer application timing differ for early and medium maturity potato cultivars. To maximize N Use Efficiency, cultivar specific N application timing techniques have to be followed.

G26

Potassium Rate Effects on Potato Yield, Quality and Acrylamide-Forming Potential

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Potassium fertilizer can significantly affect tuber yields, size, dry matter content, and fry quality. Nutrient management can affect tuber biochemistry and processing quality, which in turn can play a role in the acrylamide concentration of processed potato products. While potassium fertilizer is essential to tuber growth, its role in tuber biochemistry is not well defined. Adoption of new potato varieties and careful nutrient management may help minimize the risk posed by acrylamide formation during potato processing. The objectives of this project were to explore whether potassium fertilizer can affect tuber biochemical constituents and can help decrease the levels of acrylamide in fried potatoes. The standard variety, Russet Burbank, was compared to two promising new processing clones, AF3001-6 and AF3362-1. Three levels (0, 150, 300 lbs/A) of potassium fertilizer were applied at planting. Yield, tuber size, and specific gravity were determined at harvest. Tubers from 10ºC storage were tested for fry quality and analyzed for potential acrylamide precursors. Increasing fertilizer rates had no significant effects on tuber sugars, amino acids or phenolic compounds. Fried product color and reducing sugar concentrations were strongly correlated with acrylamide in the fries. The new varieties, AF3001-6 and AF3362-1, had significantly lower tuber reducing sugar and amino acid concentrations than Russet Burbank, and thus decreased acrylamide levels. Genetic effects on the biochemical constituents related to acrylamide formation were much greater than K fertilizer effects.

G27

Detection of Nitrogen Deficiency in Potatoes Using Small Unmanned Aircraft Systems

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Small Unmanned Aircraft Systems (sUAS) are recognized as important remote-sensing platforms for agriculture. Sensor and data processing research methods are required to make them meaningful. Experiment design was Ranger Russett (*Solanum tuberosum* L.) at 4 N-rates (112 to 449 kg N/ha) with 3 replicates arranged in a randomized block. A Tetracam, Inc. (Chatworth, CA) Hawkeye parafoil sUAS with a Agricultural Digital Camera (ADC) was used to collect color-infrared imagery from June 6th to August 15th. Pixel size varied from 2.0 to 3.0 cm, depending on altitude. Three spectral indices were calculated: (1) norm difference vegetation index [NDVI = (NIR−R)/(NIR+R)]; (2) green NDVI [GNDVI = (NIR−G)/(NIR+G)]; and (3) norm green red difference index [NGRDI = (G−R)/(G+R)]. Colored tarps calibrated the ADC and spectral indices. During late June, plot-average NDVI, GNDVI and NGRDI were correlated to leaf area index (LAI) but not to changes in leaf chlorophyll content (C_{ab}), measured by either SPAD chlorophyll meter or chlorophyll extraction. By early August, NDVI, GNDVI and NGRDI were correlated to both C_{ab} and LAI. In late July and early August, we acquired high-altitude photographs (both true color and color infrared) and WorldView2 satellite imagery, respectively. Plot-average ADC spectral indices in early August was correlated to the indices from the other sensors, but the relationships were not one to one, indicating more work is required for sensor calibration. Yield was significantly affected by N-rate (P = 0.05), but were not highly correlated to plant biophysical variables.

G28

Evaluating Sources of Aphid Vectors and *Potato Virus Y* in Eastern Oregon and Washington

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Potato virus Y (PVY) costs Oregon and Washington potato producers millions of dollars each year. PVY reduces yields and often causes necrotic lesions on potato tubers. While PVY can spread by mechanical transmission, aphids are the main vectors. Commercial and seed potato producers already implement PVY control methods, including purchasing certified seed, roughing infected plants and controlling aphid populations. However, current control tactics are not reducing PVY as effectively as might be expected and additional control methods are needed. These potato-producing regions are frequently characterized by a diverse agricultural landscape where there are multiple alternative weed and crop hosts for PVY and aphid vectors. In 2013, we surveyed weeds and agricultural crops surrounding eight potato fields in Oregon and Washington. Weeds and adjacent crops were sampled for aphids monthly using an inverted-leaf blower (D-VAC) and berlese funnels. Each weed and crop was also surveyed monthly for PVY by collecting 100 leaf samples at five different locations. Potato fields were monitored for aphids weekly using green tile traps and then sampled for PVY at the end of the season. Major sources of colonizing and non-colonizing aphids included wheat, mint, alfalfa, redstem filaree, prickly lettuce and bittersweet nightshade. Over 33 species of aphid were identified in potatoes, including: *Machrosiphum euphoribiae*, *Rhopalosiphum spp*., *Ovatus crataegarius*, and *Hyalopterus pruni*. PVY was detected in 50% of the potato fields and at lower levels in weeds and volunteer potatoes. The implications of our findings will be discussed.

G29

Potato Sustainability in Wisconsin: Results of an Industry-Wide Sustainability Assessment in 2013

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The Wisconsin Potato and Vegetable Growers Association (WPVGA) has taken a proactive approach to documenting the sustainability of their growers by working as a pioneering innovator with the National Initiative for Sustainable Agriculture (NISA). NISA is a grower-led program working to ensure behind the farm-gate sustainability by documenting progress and promoting innovative strategies to supply chain partners. The WPVGA used this approach to assess the sustainability of practices currently being used on farms by employing an entry- level assessment approach to maximize grower engagement. This process established a 2013 baseline for the industry and has helped communicate where the industry currently stands in regards to sustainability achievements. To encourage continual improvement, the association will re-assess within 5 years.

Data were analyzed and industry highlights developed into a 2-page industry and buyer educational piece. A more detailed 6-page summary was also developed to highlight research and educational needs. Analysis uses a published system combining Data Envelop Analysis with Principal Component Analysis (DEA/PCA) to document the practice adoption intensity of the industry and identify a specific suite of practices that growers could adopt to most improve the overall industry performance in regards to sustainability. Finally, the project is actively working with researchers and growers to continue improving practices that will enhance on-farm sustainability and ensure economic returns to all entities. Highlights of the process, analysis, achievements and documentation of the industry will be presented at the PAA conference.

G30

Evaluation of the Vital Farms PIP-200 System for Aeroponic Production of Seed Potato Mini-Tubers in Alberta

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The Vital Farms Potato Incubator (PIP-200), an aeroponic (media-free) seed potato production system designed to optimize the yield and quality of seed potato mini-tubers, was evaluated at the Crop Diversification Centre South in Alberta, Canada. Over 17 different varieties were evaluated in the system over three cropping cycles in the past 16 months. The mean yield of nuclear seed potatoes produced in the aeroponic system was 3.8 tubers per plantlet in the first cycle of evaluation and improved to almost 19 tubers per plantlet by the third round, depending on the variety. Little information is available for producing North American varieties in such a system and more research will be required to optimize production. The full potential of the PIP-200 system has not been witnessed yet. A partial economic assessment was conducted. An estimated 20 tubers per plantlet may be required for this method of production to be widely adopted by seed potato producers in Alberta or other parts of North America. This level of production seems attainable based on the observations made during the evaluation. Additional work with this system or a modified model (PIP-150) may move us past the tipping point.

G31

Vietnamese Farmers Successfully Demystified Rapid Multiplication Technology to Revolutionize the Potato Industry

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In a post war devastated country, hungry potato farmers sought to feed themselves and their communities. A scientist with tissue culture training in France, germplasm from CIP, and determined farmers were key ingredients that made this revolution possible. Initially 10 farmers were trained to do tissue culture in their homes using a corner of a bed room for an improvised laminar flow, coconut water as a basic nutrient and the windows for light to grow the invitro plants. The invitro plants were densely transplanted to beds from which apical cuttings were taken and re-rooted to produce either more "mother plants" or rooted in 3 cm diameter banana leaf pots which would be planted in commercial fields for seed and table potatoes. The past 33 years, farmers have consistently sold over 2 million rooted cuttings annually. The number of farmers supplying these rooted cuttings has ranged from 10 to 4. These farmers have successfully demystified what was a sophisticated technology and have become successful capitalists. They have improved their farms, purchased professional laminar flows, and bought motorcycles, cars, even baby grand pianos! Yet the technology utilized is simple, low cost and profitable.

What was the impact of this demystified technology? Severe Bacterial Wilt infection became a non-issue so farmers keep seed grown from cuttings for 3-6 generations before bringing in new rooted cuttings as their initial planting material. Farmers quickly adopted and multiplied new varieties on demand. Yields averaged over 30 t/ha under irrigated dry season conditions as well as during the rainy season. These hard working, innovative farmers created a powerful economic impact on the potato growing communities of the southern highlands.

G32

SCRI-Acrylamide Agronomic Trials Identified Exceptional Clones with Low Acrylamide

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Acrylamide, a suspect human carcinogen, is present in potato French fries and chips after processed at high temperature. The SCRI-Acrylamide project started from 2011 with the purpose of identifying potato clones that produce lower acrylamide while maintaining current good traits. Agronomic trials of the project were conducted with multiple replications at six locations (ID, ME, MN, OR, WA, WI) in 2013 to evaluate yield, quality, post-harvest fry color and sugar profiles of selected frying clones. Those clones have showed promising agronomic traits, good fry quality, and low acrylamide forming potential in previous studies. Results have indicated that throughout the six locations, some clones (AF3001-6, AF4296-3) consistently out-yielded others, some (A02507-2LB, W8152-1rus) had specific gravity that fell into the commercially required range. These advanced clones also showed low incidence of internal defect and length to width ratio suggesting good shape for frying potatoes. Fry color, sugar profiles (sucrose and glucose), and sugar end defects are monitored at 0, 16, and 32 weeks subsequent to harvest to keep track of fry quality change during storage to select clones that persist well until late May. In addition, data has been collected on individual tuber specific gravity variation within a clone, which is an important indicator of consistency of tuber solid content. Clones such as A02507-2LB showed less tuber-to-tuber variation than others across sites. Those data have been referred by the processor coordinators for their commercial production. Other studies are underway to investigate how tuber maturation affected by different N treatments can influence post-harvest fry quality and acrylamide level.

G33

Potato Fingerprinting Using Genome-Wide SNPs

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With commercial seed production of over 500 different potato varieties and breeding lines in the US and Canada, correctly identifying a particular potato clone is important and can have large economic consequences. Accurate identification of specific potato varieties can be a challenge based on morphological characteristics alone (tuber shape, skin or flesh color, flower color). During the past 25 years, molecular tools such as isozyme electrophoresis and simple sequence repeats (SSRs) have been used to successfully distinguish potato clones. One of the major outcomes from the AFRI/USDA-funded SolCAP project was development of genome-wide, SNP-based markers for potato. The Infinium 8303 Potato SNP Array was used to genotype over 300 North American tetraploid potato varieties and breeding lines (including closely related clones), as well as four tetraploid mapping populations. Tetraploid genotypes were called for 3,702 quality filtered SNPs for all potato samples using the SolCAP custom five cluster calling parameters. Over 1,000 SNP markers uniquely distinguished all tetraploid potato varieties and breeding lines. This demonstrates the power of this marker technology for fingerprinting in potato. The SNP fingerprinting analysis is currently the most accurate and robust method to distinguish potato varieties.

G34

National Chip Processing Trials: Four Years of Progress

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The USPB-funded National Chip Processing Trial is an effort to synergize the strengths of the public breeding programs in the US to identify improved chip-processing varieties for the industry. The specific objectives of the trials are to 1) develop a high yield, late storage variety that will chip with good color and store later than Snowden and 2) develop an early bulking variety that will be less susceptible to internal heat necrosis than Atlantic. Cooperating breeding programs inlcude the USDA (ID and MD) and land grant universities (CO, ME, MI, MN, NC, ND, NY, OR, WI, and TX). Collaboration among the breeders, potato growers, and processors has been key to the success of the program. The coordinated breeding effort includes early stage evaluation of key traits (yield, specific gravity, chip color, chip defects and shape) from coordinated trials in 11 locations (CA, FL, NC, MO, and TX in the south and MI, MN, NY, ND, OR, and WI in the north). Since the inception of the trial in 2010, 622 different potato entries, including reference varieties, have been evaluated. The data for all the lines tested are summarized on a searchable, centralized database housed at NCSU. More than 30 promising new breeding lines from the trials have been fast-tracked for larger-scale commercial trials and processor evaluation. The NCPT is also a feeder for the National USPB/SFA trials.

G35

Improving Potato Germplasm Collecting Technology

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There is ample advice about the best way to sample genetic diversity in a population growing in the wild. But the practical limitation is often the fact that sufficient collectable propagules are not available. In the case of potato collecting in the USA, this limitation is manifest in at least three important ways, even when the collector is fortunate enough to find the rare plants. First, collectable tubers and seeds may not be present, and plants may be too stressed or old to make transplanting into soil a strategy likely to be successful. Second, in some locations, seed-eating insects have infested nearly all available fruit. Third, in some cases, large populations without fruit or tubers cannot be adequately represented in a few collected individual clones. We developed technology to address these problems. An in vitro collection technique for the field was developed that roots and rejuvenates old shoots, using antibiotic medium that requires no sterile hood. A field insecticide treatment was developed that effectively kills fruit grubs in *S. fendleri* without harming seed development and germination. We collected pollen from a large in situ population of *S. jamesii*, and kept it viable until it could be used to successfully pollinate surrogate mothers growing at the genebank. We anticipate that these techniques will increase the quantity and quality of germplasm collection from the wild, providing a greater return on the investment of time and funds spent on expeditions.

G36

Crestone Russet and Mercury Russet: Two New Russet Potato Cultivars from the Colorado Potato Breeding and Selection Program

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Crestone Russet and Mercury Russet are both dual purpose selections with fresh market and processing potential. Crestone Russet, previously known as CO99053-3RU, was derived from a cross of AC91014-2 and Silverton Russet. Crestone Russet has a higher total yield potential (501 cwt/A) and a higher percentage of US No. 1 tubers (89%) than Russet Norkotah. Crestone Russet has an 84 day dormancy period at 45F, slightly shorter than Russet Norkotah. The tubers have good storability and are moderately resistant to hollow heart and resistant to second growth, blackspot bruise, and shatter bruise. Crestone Russet is resistant to early blight and *Verticillium* wilt. Mercury Russet, previously known as CO99100-1RU, was derived from a cross of AC93047-1 and Silverton Russet. Mercury Russet has a total and US No. 1 yield potential comparable to Russet Norkotah. This clone has an early maturity and a very short dormancy of 62 days at 45F. Tubers are resistant to hollow heart, second growth, blackspot bruise, and shatter bruise. Mercury Russet has excellent processing quality and early tuber bulking making it a possible replacement for Russet Norkotah. Advanced testing, seed increase, and commercial evaluation for both cultivars was assisted by the Southwest Regional cooperators and Western Regional cooperators, seed and commercial growers and other private cooperators in the Western United States. Both cultivars were evaluated in Western Regional Trials in 2009-2011. Certified seed stocks for Crestone Russet and Mercury Russet are available from producers in Colorado.

G37

Masquerade, Midnight Moon, and Red Luna: Three New Specialty Potato Cultivars from the Colorado Potato Breeding and Selection Program

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Masquerade, Midnight Moon, and Red Luna are fresh market specialty clones. Masquerade has round tubers with a purple and white bi-color skin and yellow flesh. Previously known as AC99329-7PW/Y, Masquerade was derived from a cross of Inka Gold and A91846-5. This clone has a very high total yield (522 cwt/A) and a high percentage of US No. 1 tubers. Masquerade has an extremely short dormancy of 39 days at 45F, much shorter than Yukon Gold. Taste evaluations indicate that Masquerade has good flavor attributes. Midnight Moon has attractive round tubers with purple skin and dark yellow flesh. Previously known as AC99330-1P/Y, it is a half-sib to Masquerade, and is derived from a cross of Inka Gold and A89655-5DY. Midnight Moon has a high total yield (495 cwt/A) and a small tuber size profile. Tubers are resistant to hollow heart, blackspot bruise and second growth. Red Luna has oblong tubers with red skin and yellow flesh. Previously known as CO97233-3R/Y, it was derived from a cross of CO94218-1R and VC0976-5R/Y. Red Luna has a higher yield potential than Yukon Gold (477 cwt/A). Tubers are resistant to blackspot bruise and shatter bruise. Masquerade, Midnight Moon and Red Luna have shown field resistance to PVY. Certified seed stocks of these specialty cultivars are available from producers in Colorado.

G38

Linkage Map and QTL Analysis for Internal Heat Necrosis in a Segregating Tetraploid Potato Population

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Decreasing costs of high throughput next generation sequencing technologies have led to the published sequence of the potato genome and development of the Infinium 8303 potato SNP array. This array has been shown to possess many dosage sensitive markers, making it ideal for analyzing tetraploid potato populations. Utilizing this new technology, we have built linkage maps and performed QTL analysis on the 4x population B2721 for internal heat necrosis (IHN). B2721 was developed from the cross Atlantic x B1829-5. Atlantic is IHN susceptible and B1829-5 is IHN resistant. B2721 was mapped and analyzed for QTL in the past using AFLP and SSR markers. This allowed us to make comparisons between maps as well as combine markers to give us better representation of the genome. The SNP linkage map for Atlantic contains 498 markers and represents 1,131cM of the genome, and the SNP linkage map for B1829-5 contains 221 markers and represents 907cM of the genome. Both maps contained markers on all 48 chromosomes. Maps with combined markers allowed us to anchor previously unanchored linkage groups to the published genome as well as better assign marker location, giving more precise locations for previously determined QTLs. QTLs on chromosomes 5, 12, and 7 were reaffirmed with new QTLs being reported on chromosomes 9, 2, and 1. The QTL on chromosome 1 on the B1829-5 map explained 31% of the variation with a LOD score of 9.3. SNP markers with annotation for gene function and co-located with QTLs are also reported. This information will be helpful in developing markers for IHN resistance.

G39

Generation of Herbicide-Resistant Lines of Potato Using Genome Editing

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Genome editing has rapidly become a new tool for crop improvement and is revolutionizing genetic engineering across eukaryotic species. The rapid adoption of genome editing is the direct result of recent developments in nuclease technology, including transcription activator-like effector nucleases (TALENs) and clustered regularly interspaced palindromic repeats/CRISPR-associated systems (CRISPR/Cas). To date, TALENs and CRISPR/Cas have successfully been used to generate modified lines of rice, tobacco, barely and Arabidopsis and produce targeted modifications in cell cultures of wheat and sorghum. The limited ability to regenerate modified events in plant species is most likely due to the negative impact nuclease activity has on cell fitness and can be countered by giving modified cells a selective advantage. In this study, modified lines of potato were regenerated by incorporating herbicide-resistance mutations into the endogenous acetolactate synthase (ALS) gene and applying an ALS-inhibiting herbicide for selection. Modification of ALS and incorporation of exogenous sequence downstream of ALS was facilitated by use of a geminivirus which promotes rates of homologous recombination and eliminates the requirement for stable integration. The use of geminiviruses and exploitation of ALS as a target site provides a strategy for targeted gene modification through homologous recombination.

G40

Purple and White Potatoes, even after Processing, Suppress Colonic Interleukin-6 Expression, a Pro-Inflammatory Cytokine, in a High-Fat Consuming Pig Model

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We previously demonstrated that both white (WP) and purple (PP; purple > white; baked > chips) potato suppress colon cancer cell proliferation and elevates apoptosis. Colon cancer kills ~50,000 Americans/yr. High-fat diet (HFD) elevated colonic inflammation provides a conducive environment for colon cancer. Interleukin-6 (IL-6) is linked to increased cell proliferation in colitis-induced colon cancer. We hypothesized that PP/WP, even after processing, suppresses IL-6 in HFD consuming pig model. To test this hypothesis, we performed 1) A prevention study where 64 pigs, 3 wk post-weaning consumed one of 8 diets: standard diet (SD), HFD, and HFD with PP/WP as raw/ baked/chips (10% w/w) for 13 wk, and 2) A reversal study where pigs (12 wk on HFD) consumed HFD containing 10/20% PP/WP chips for additional 5 wk (n = 8/group). IL-6 levels (qPCR) were elevated in HFD compared to SD group. Both PP and WP (baked and raw) suppress IL-6 expression compared to the HFD control (P = 0.07, 0.01, 0.05, 0.03 for PP raw, PP baked, WP raw, WP baked, respectively). IL-6 correlated with Ki-67 proliferative zone, a marker for increased colon cancer risk (immunofluorescence) and pro-inflammatory TNF-α (qPCR; r = 0.31, 0.45; P = 0.019, 0.001, respectively). However, in the reversal study only 20% chip supplementation could suppress IL-6 expression (P = 0.05, 0.06 for PP/WP). Greater levels of chips were needed to reverse elevated IL-6 due to the loss of bioactive compounds. Thus, it is critical to understand processing effects on anti-inflammatory properties of food products *in vivo*.

G41

Purple Potato, even after Processing, Suppresses Colon Cancer Stem Cell Growth *In Vitro* Independent of p53

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Anthocyanins have shown to exhibit anti-cancer activity *in vitro*, *in vivo* and in human clinical trials. Purple potatoes (PP) are becoming popular for their putative health benefits due to anthocyanins. We have previously shown that PP anthocyanin-rich extracts suppress early (HCT 116) and advanced (HT-29) human colon cancer cell growth but their effect on colon cancer stem cells (CSCs) is not known. Unlike anthocyanin rich fruits such as berries, potatoes are almost always processed before consumption. Hence, we evaluated the anti-cancer efficacy of baked PP extract (PE) on CSCs. The Wnt signaling pathway is a critical regulator of normal colon stem cell proliferation and its activation is associated with transformation to CSCs. Furthermore, inactivation of p53, a tumor suppressor gene, in CSCs is responsible for tumor invasion/metastasis. Thus, we measured proteins in Wnt signaling and apoptosis pathway using western blot in PE treated CSCs with/without functioning p53. PE suppressed ($P < 0.05$) cytoplasmic and nuclear levels of β-catenin, the critical downstream effector of Wnt pathway. Bax and cytochrome c, proteins downstream of p53 and involved in mitochondrial mediated apoptosis, were elevated ($P < 0.05$) upon PE treatment. Interestingly, similar results were seen in CSCs without p53 indicating that PE elevates apoptosis via p53 independent mechanisms. Our results suggest that PP, even after processing, eliminate human CSCs *in vitro* by suppressing the Wnt signaling pathway and activating mitochondrial apoptosis independent of p53. We are currently evaluating the anti-cancer activity of PE on CSCs in a rodent model of colon carcinogenesis.

G42

Potatoes Can't Take the Heat: Effects of Cultivar and Processing on Global Metabolite/Nutritional Profiles

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Color-fleshed potato consumption increased in the last decade due to their putative health benefits. Our previous work suggests cultivar and processing alter potato anti-cancer bioactivity, but the effect of cultivar vs. processing on potato nutritional quality is largely unexplored. We hypothesized that interaction between cultivar and processing would determine the metabolite/nutrient composition of potato products. To test this, we compared metabolite profiles (UPLC-QTOF-MS^E) and determined vitamin C levels (HPLC-PDA) in 6 potato cultivars (2 white, 2 red, 2 purple) processed via 6 methods (raw, baked, steamed, microwaved, chipped, fried). Clear separation of samples by processing method in principal component analysis demonstrated processing had a more pronounced effect than cultivar on global metabolite profiles. Differences for the majority of metabolites (766 of 1,151 total identified metabolites) were due to a combination of cultivar, processing, and their interaction. Cultivar/processing type was predicted with > 90 % accuracy via a regression analysis based on decision trees, demonstrating substantial differences between the groups. Vitamin C results followed a similar trend as major differences were due to processing over cultivar (raw > baked = steamed = microwaved > chips > fries at $P \leq 0.02$). Our findings suggest understanding of interaction between cultivar and processing will help to develop food products with predictable health benefits.

G43

The Growth in Potato Production and Inception of Secondary Potato Markets in India

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After the opening of the Indian economy in 1991, rapid expansion of Quick Service Restaurants (QSRs) created a new market for frozen potato products in this mainly vegetarian nation. Initial market research identified a number of barriers to successful growth of the industry. New potato product adoption would depend on adequately addressing the tastes and preferences of Indian consumers. Also of concern was the ability to procure adequate quality raw product locally. Foreign investment in research led to development of a desirable processing quality cultivar. As a result, India is now meeting domestic demand for frozen processing raw product through local production. We analyze the growth rates of potato production in India over the last 20 years and forecast future growth of the industry. We also examine the role of potato production in the Indian economy considering how raw product quality will impact future growth in the processing sector. We also analyze how first mover advantage of multinational companies has led to capturing of market share in the Indian frozen food market.

G44

Economic Impact of Zebra Chip in Potato

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Zebra Chip (ZC) exposes growers to the risk of economic losses. We develop enterprise budgets to evaluate how the competitive position of eight major US potato producing regions would be impacted under various price and ZC management cost scenarios. When using three year (2010-2012) average marketing year prices for “all potatoes” and three year average (2010-2012) yields obtained from USDA-NASS, results highlight the inability of Pacific Northwest growers to sustain a profit if they adopt a routine insecticide program for ZC protection that begins at plant emergence. When analyzing the fresh and processed markets separately, we consider how increased operating costs affect risk in the already volatile fresh market and analyze how the uncertain threat posed by psyllid pressure could jeopardize the ability of growers to negotiate profitable processor contract prices.

G45

Evaluation of Potato Anaerobic Digestate as a Renewable Alternative to Peat Moss in Horticultural Substrates

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Potato peels and other low-value wastes from potato processing are currently being used as cattle feed or fermented to produce fuel-grade ethanol. The anaerobic fermentation of food wastes, including potato processing wastes, produces biogas (principally methane), which can be used directly for heating or for the production of electricity. After fermentation is complete a wet digestate remains, which after drying was found to have physical characteristics similar to peat moss. This led to our evaluation of the dried digestate as a peat moss replacement in horticultural potting substrates. Physical and chemical properties of the digestate were in the desired ranges for potting substrates. As a starter substrate (for tomato, marigold and basil seed germination), the digestate alone or 1:1 with vermiculite performed as well or better than 1:1 peat/vermiculite with or without added chemical fertilizer. Three transplant substrate formulations were also tested: 100% digestate; 1:1 digestate/vermiculite; and 1:1 peat/vermiculite. All three treatments received a slow-release chemical fertilizer and dolomitic limestone. Three-week-old tomato and marigold seedlings were transplanted into pots (2.5 L) containing each of the formulations. Changes in plant heights and dry weights were measured after 4 weeks. Growth of both species for both substrates containing potato digestate was equal to or superior to plants grown in 1:1 peat/vermiculite. These results indicate that potato anaerobic digestate could be an excellent renewable replacement for peat moss in horticultural substrates.

G46

Sprout Inhibition by α,β-unsaturated Aliphatic Carbonyls – Discovery, Chemistry and Physiological Responses

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Aliphatic α,β-unsaturated aldehydes and ketones represent new chemistry in the development of commercial potato sprout inhibitors. Here we describe the serendipitous discovery of these compounds, review their chemistry and metabolism, and summarize salient physiological responses key to their mode of action. The initial discovery came from studies on the physiology of aging in seed-tubers. (*E*)-2-hexenal (T2H), a volatile product of lipid oxidation and biomarker of membrane deterioration, was shown to increase many-fold with advancing tuber age. Young seed-tubers were treated with T2H to determine if this compound could induce plant growth symptoms characteristic of older seed-tubers (increased stems, rapid plant emergence and establishment). However, T2H completely inhibited growth regardless of seed-tuber age. The α,β-unsaturated carbonyl moiety was determined to confer the greatest toxicity compared with compounds of equivalent carbon number but lacking either the carbonyl group or double bond. Further work demonstrated that the 8 to 10-carbon aldehydes and ketones were highly effective as sprout inhibitors. These compounds are metabolized into saturated ketones, 2^{o} alcohols, saturated aldehydes and 1^{o} alcohols, and unsaturated 1^{o} alcohols, which contribute to rapid decline in residue levels post treatment. The α,β-unsaturated ketones induce a transient increase in respiration rate, progressive desiccation of sprouts and loss of ability to modulate oxidative stress. The result is necrosis of sprout tissue within 24-36 h of exposure. Depending on cultivar and storage temperature, season-long sprout control is possible with two to three applications. 3-Decen-2-one was recently registered (SmartBlock®) for sprout control in commercial storages.

G47

Global Development and Commercial Launch of 3-decen-2-one (SmartBlock®) for Potato Sprout Control

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SmartBlock (3-decen-2-one) is a 10-carbon α,β-unsaturated ketone which was discovered at Washington State University. This molecule has been licensed to AMVAC and tested extensively on many varieties of potatoes under a wide range of storage conditions in many countries including USA, Canada, Japan, Israel, UK, Netherlands, France and Germany with excellent results. SmartBlock was registered for use in USA and Canada as a Biopesticide in 2013 and is exempt from the requirement of a tolerance (MRL). The product was successfully launched last year in both countries. When applied through commercial thermal fogging equipment, the active ingredient vaporizes easily and quickly destroys the rapidly-growing meristematic sprout tissue. The primary breakdown metabolites, 2-decanone and 2-decanol, also exhibit good activity and collectively provide extended sprout control for approximately 2-3 months or even up to 6 months depending on the potato cultivar and storage temperature.

Growers and applicators alike are impressed with the product's features such as ease of application, excellent distribution of vapor throughout the potato pile, consistent efficacy, versatility, prolonged sprout control activity and restoring tuber dormancy. Treated tubers also exhibit excellent post-treatment qualities such as tuber firmness and exhibit no adverse effects on reducing sugar levels, taste or texture and exhibit good shelf life characteristics. Storage managers who have combined SmartBlock with low-rates of CIPC have obtained excellent long-term sprout control and low CIPC-residue tubers. Currently, SmartBlock appears to provide the first true alternative to CIPC for potato sprout control. Commercial performance data and future global opportunities will be presented.

G48

Chlorpropham Sprout Inhibitor Residue on Fresh-Pack Potatoes

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Chlorpropham (CIPC) is applied as thermal aerosol for potato sprout control in storage. A spray application of CIPC as a diluted emulsifiable concentrate (EC) is often applied after washing potatoes and before packaging in consumer-sized packages. The objectives of the study were to document the level of CIPC in potatoes before and after packaging and to evaluate the impact of the CIPC spray application. Four potato packing houses were sampled multiple times over two consecutive years. Triplicate samples were collected as the potatoes (Russet Burbank and Russet Norkotah) were delivered from storage, after washing, and after CIPC-EC application and packaging. CIPC residues were quantified by the Idaho Food Quality Assurance Laboratory via GC/MS. Samples were stored for up to 8 weeks in a warehouse condition to simulate the delay seen between packaging and final consumption. After one month samples were rated for sprout development and weight and resampled for CIPC residue. All CIPC residues were found to be below the maximum allowable residue in the United States. Mean CIPC residue levels from storage tended to decrease from December to June. Residue levels on samples delivered from storage and final packed product were statistically equivalent. CIPC residue levels on washed samples were significantly lower ($p=0.10$) than the initial and EC applied samples. Washing potatoes resulted in a decrease of 1.4 to 2.3 ppm. The spray CIPC application added 1.5 to 1.9 ppm which resulted in no difference in total residue after packing. In general, evaluation of sprout development in samples held under warehouse conditions indicated the EC application provided better sprout control although this advantage was not as apparent shortly after harvest or with higher initial CIPC residues.

G49

Miniaturization of Post-Harvest Sprout Control Chemical Application

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Treating small quantities of potatoes with post-harvest chemicals in a quantitative manner can be problematic, especially with thermal fog application using rates as low as 5 to 10ppm. Scientists at 1,4GROUP have developed methods to accurately treat from 3 pounds to 3 tons of potatoes with desired levels of sprout control chemicals. These methods allow for reproducible, replicated experiments needed for testing of multiple chemicals at several different rates and timings.

G50

Biochemical Properties and Expression Analysis of Potato Cytokinin Oxidases during Tuber Dormancy

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At harvest and for an indeterminate period thereafter, potato tubers are dormant and will not sprout. Tuber dormancy is lost during postharvest storage and the subsequent sprouting results in the loss of tuber processing and nutritional qualities. Endogenous cytokinins have been posited to play a pivotal role in the reactivation of tuber meristems during dormancy exit. However, the cognate mechanisms controlling endogenous cytokinin content in tuber buds during dormancy progression are unknown. Cytokinin dehydrogenase/oxidase (CKX) is the principal enzyme of cytokinin metabolism catalyzing the irreversible oxidative cleavage of the N^6-isoprenoid side chain of naturally occurring cytokinins. Five CKX-like genes were cloned from tuber bud RNA. Protein extracts from yeast expressing full-length clones of all five CKX-like genes displayed *in vitro* CKX activity using isopentenyl adenosine and artificial electron acceptors. Both the electron acceptor and substrate preferences of the expressed proteins differed between the five enzymes. Genes encoding all five CKX proteins were expressed in tuber bud tissues during dormancy progression. There was no change in apparent *in planta* CKX activity during either natural or chemically forced dormancy progression. Similarly although expression of individual *StCKX* genes varied modestly during tuber dormancy, there was no clear correlation between *StCKX* gene expression and tuber dormancy status. Thus although CKX gene expression and enzyme activity are present in potato tuber meristems throughout dormancy, they do not appear to play a significant role in the regulation of cytokinin content during tuber dormancy progression.

G51

Effect of Harvesting Time of Seed Tubers, Reconditioning and GA_3 Treatment on Dormancy Breaking of 'Superior' Potato Tubers

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There have been four cultivation types of potato production in Republic of Korea because of rainfall and high temperature period (Jul.-Aug.). Superior has been produced through spring cultivation (from Mar. to Jun.) and winter cultivation (from Dec. to Apr. in the twofold P.E film house). To produce Superior at autumn cultivation (from Aug. to Nov.), seed tubers should be stored for nine months after summer cultivation (from May to Oct.) because of its dormancy. To break the dormancy of Superior, we harvested the seed tubers from the 63 days to 92 days after sowing on 28. Mar. and the seed tubers were treated with reconditioning temperature and GA_3 soaking[4°C for 14 days and 20°C constant, 87% RH, and soaked in GA_3 solution(1ppm, 1 hr.) at 60 days after storage]. The mean sprouting days(MSD) was required 73 days at the tubers harvested at 63 days after sowing but the tubers of controlled storage(20°C constant, 87% RH) were sprouted after 95 days. The MSD of tubers harvested 74 days after sowing was 67 days but that of tubers treated with controlled storage was 92 days. In autumn cultivation(from 23. Aug. to 15. Nov.) grown in the container with artificial soil, the total tuber weight of the seed tubers harvested at 63 days in spring cultivation was 231.6g/plant and its seed tuber weight was 209.9g/plant. The total tuber weight of seed tubers harvested at 74 days in spring cultivation was 257.5g/plant and its seed tuber weight was 252.2g/plant. The present study showed that the reconditioning temperature and GA_3 soaking treatment gave highly effective dormancy breaking to 'Superior' potato tubers harvested before maturity.

G52

Weight Loss in Storage: Russet Burbank and New Potato Cultivars

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There is keen interest in identifying potato cultivars with quality fresh and processing characteristics and long term storability. Weight loss (shrinkage) can negatively impact quality and economic returns for all market sectors. An ongoing research project at the University of Idaho Kimberly Potato Storage Facility has evaluated potential new cultivars for storability, including weight loss, compared to Russet Burbank (RB). RB whole tuber percent fresh weight loss was measured in 8 storage years along with additional cultivars. Weight loss data was collected on 3 replications of ~4.5 kg sample size of sound, unwashed tubers. Fresh weights were recorded prior to placing in storage. Samples were held at curing conditions of 12.8°C and 95% RH for 14 days, ramped at 0.3°C per day until final holding temperatures of 5.6, 7.2 and 8.9°C and 95 %RH. At approximately 60 days after harvest, tubers were aerosol treated with 22 ppm chlorpropham for sprout control. Sample bags were weighed monthly (September to June).

After 9 months in storage total percent weight loss in RB averaged 5.9% (mean of 8 years and 3 storage temperatures). Percent weight loss range in RB was 5.0 to 9.1%. By comparison, percent weight loss in 11 released cultivars, 8 had more total weight loss than RB and 3 were statistically equal to RB. Weight loss averaged 2.0% (minimum 1.8% and maximum 2.5%) in the first month of storage for RB. Additional months in storage showed an average loss of 0.6% per month. Among the 11 released cultivars, in the first month of storage, 7 had higher, 1 had lower and 3 had weight loss statistically equal to RB. Weight loss in storage can vary significantly based upon variety, year, and duration in storage and is an important consideration in storage management decisions.

G53

The Origin of Russet Burbank (Netted Gem), a Sport of Burbank

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Russet Burbank is the most successful North American potato cultivar of the past century. It dominated the fresh market for decades and has become the foremost French fry processing variety. Russet Burbank set the standard for taste and texture of baked potatoes and French fries and has made an indelible impact on the North American potato industry. Yet, despite the importance of Russet Burbank to our shared cultural heritage, the widely disseminated accounts of its origin are incorrect. The most popular account, based on a paragraph written by Luther Burbank, states that the Russet Burbank variety was introduced by the Colorado potato grower Lou Sweet in 1914. This statement is not consistent with the literature of that time. It is likely that Russet Burbank, a sport of Burbank, originated earlier and that it was introduced in 1902 as Netted Gem by L. L. May & Co. (St. Paul MN). Seed tubers of the Netted Gem variety were originally acquired from a Montana rancher who, in 1895, found unique russet tubers growing in a field that had been planted the year before with potatoes. In L. L. May's 1902 catalog, Netted Gem was promoted as "a Montana seedling; handsome, prolific, with unsurpassed quality and unequaled keeping quality." Russet Burbank is one of several synonyms for Netted Gem and the two names were used interchangeably for many years. In this report, we use information gleaned from extension bulletins, trade journals, textbooks and the scientific literature to trace the fascinating, early history of the Russet Burbank potato.

G54

Vacuolar Invertase Gene Silencing in Potato Decreasing the Frequency of Sugar-End Defects

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Sugar-end defect is a tuber quality disorder and persistent problem for the French fry processing industry that causes unacceptable darkening of one end of French fries. This defect appears when environmental stress during tuber growth increases post-harvest vacuolar acid invertase activity at one end of the tuber. Reducing sugars produced by invertase form dark-colored Maillard reaction products during frying. Acrylamide is another Maillard reaction product formed from reducing sugars and acrylamide consumption has raised health concerns worldwide. Vacuolar invertase gene (*VInv*) expression was suppressed in cultivars Russet Burbank and Ranger Russet using RNA interference to determine if this approach could control sugar-end defect formation. Tuber bud and stem end *VInv* mRNA accumulation decreased through 5 months of storage in multiple silencing line of Russet Burbank compared to Russet Burbank controls. Acid invertase activity and reducing sugar content decreased at both ends of tubers. Sugar-end defects and acrylamide content in fried potato strips were strongly reduced in multiple transgenic potato lines. Thus vacuolar invertase silencing can minimize a long-standing French fry quality problem while providing consumers with attractive products that reduce health concerns related to dietary acrylamide.

G55

Effects of Simulated Glyphosate and Dicamba Drift in Seed Potatoes

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The intended commercial release of Roundup Ready 2 Xtend Soybeans in 2015 will allow the use of glyphosate and dicamba as postemergence weed control, increasing the potential for exposure to seed potato plants. Unintended exposure of herbicides on seed potato can result in poor germination of seed tubers the next season and reduce yield. It is unknown what effects glyphosate plus dicamba tank mixtures will have on seed potato yield and on the tubers that are planted the next season. The objective of this experiment was to determine the effect glyphosate and dicamba on yield of the first generation exposed to the herbicides and the effect on emergence and yield of the second generation tubers (daughter tubers) when planted the next season. A randomized complete block design with a factorial arrangement of treatments were planted on 18 June 2013 in Grand Forks, ND on the Northern Plains Potato Growers Association dryland research farm. The cultivars 'Dark Red Norland' and 'Dakota Pearl' were utilized because they are the most commonly grown red- and white-skinned cultivars, respectively, in the Red River Valley. Simulated drift rates were applied over the top of plots to represent 0, 8, and 16% of a field use rate (840 g ae ha^{-1}) of glyphosate and 0, 4, and 8% field use rate of dicamba (560 g ha^{-1}) during late bulking. Harvested yields from 2013 were generally similar across treatments. Data on germination of seed tubers produced under the treatments in 2013 will be presented.

G56

Seed Size and Spacing on Profitability for Dry Matter Production in an Organic, Dryland System in Western Nebraska

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Can a reasonable profit be made from growing potato exclusively for dry matter? The objective of this study was to determine whether growing potatoes under harsh dryland conditions and under organic-farming protocol to keep costs low is feasible in western Nebraska. To accomplish this, farming practice involved only seed cutting and cultivating. As reported earlier, 'Atlantic' was found to be the most promising cultivar out of several tested. Using Atlantic, the aim was to identify the most profitable seed size and spacing to plant, that is the right balance between seed cost and yield to achieve the highest net income. No irrigation, fertilization or pesticides were applied. Rain from planting to harvest was 6.2 inches, 57% of average, and temperature was 1-2F above average. Cut seed-pieces, weighing 1.5. 2.0, 2.25, 2.5, or 3.0 ounces, were planted at 5, 9, 12, 15, and 18 inches in-row spacing in 36-inch rows at Scottsbluff, NE following dry beans. The highest yields, >100 cwt/a, and lowest stand, <70%, were obtained when plants were spaced 6 or 9 inches regardless of seed weight. Seed weight did not play a significant role. Net income calculations assumed fixed costs at $70/a; cut seed cost at $10/a, and sales for dehydration at $4/cwt. Applying yields obtained, a profit greater than $100/a were achieved when seed pieces less than 2.5 oz were planted 15 or 18 inches apart. Although this study needs to be repeated, based on this and earlier results, it appears promising that under the semiarid conditions of western Nebraska, it may be economically feasible to grow a crop targeted for potato dehydration.

G57

Analysis of the Regulation of Tuber Phytonutrient Metabolism

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Tuber secondary metabolites include phenolic acids, flavonols, anthocyanins, and carotenoids, compounds important for both human health and plant physiology. Tuber development decreased products from later branches of the phenylpropanoid pathway, including petunidin 3-O-(p-coumaroyl)rutinoside-3-glucoside. Violaxanthin and lutein were the two most abundant carotenoids and decreased 30−70% in yellow and white potatoes. Sucrose decreased with development in all cultivars and was highest in purple potatoes. Most phenylpropanoid and carotenoid structural gene expression decreased during development. Red and purple-flesh genotypes had increased PAL enzyme activity, and elevated expression of most phenylpropanoid structural genes, including a novel anthocyanin *O*-methyltransferase. To identify the transcription factors involved, 15 were selected based on phylogeny. *Anthocyanin1* (*StAN1), basic Helix Loop Helix1 (StbHLH1)* and *StWD40* were more strongly expressed in red and purple potatoes and also associated with environmentally mediated phenylpropanoid increases. Expression of 12 other transcription factors was not associated with phenylpropanoid content, except for *StMYB12B*, which showed a negative relationship. Treatment of potato plantlets with sucrose induced structural genes, *AN1*, *bHLH1*, *WD40* and, *SUSY1*, *SUSY4* and *INV2*. Transient expression of *StAN1* in tobacco leaves induced *bHLH1,* structural genes, *SUSY1, SUSY4* and *INV1* and increased phenylpropanoid amounts. Promoter analysis revealed the presence of MYB and bHLH cis-regulatory elements on sucrolytic gene promoters and sucrose responsive elements on the *AN1* promoter, suggesting an interesting dynamic between *AN1,* sucrose, and sucrose metabolic genes in modulating potato phenylpropanoids.

G58

Crystal Green® as a Slow Release Phosphorus Fertilizer Source for Potatoes

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Phosphorus (P) is an essential plant nutrient and an important input for maximized potato yields and quality. Potatoes have a substantial P demand during bulking, however, phosphate availability may be limited late in the season due to phosphate fixation in the soil. Crystal Green (CG) is a high purity, sustainably produced, slow release fertilizer with the analysis 5-28-0 +10% Mg. CG is not coated so it is not a controlled release product. It is a slow release product due to its low water solubility and high citrate solubility, resulting in a phosphorus source that is "plant-activated". This slow release property is potentially beneficial for potato crops since more than half of the P uptake occurs later in the season. In 2012, five locations tested straight CG as the only P source for potatoes. Overall, results showed that at the recommended rate of P application, the use of CG resulted in potato yields and quality comparable to the industry standard. CG proved to be a viable agronomic alternative to monoammonium phosphate (MAP) or triple superphosphate. In 2013, 14 potato trials looked at optimizing the season-long plant availability of P by combining CG with MAP. Providing 25%-50% of the P requirement from CG had benefits for P availability as evidenced in the petiole P concentrations. In some cases, the inclusion of CG had a positive impact on the total marketable yield or the grade and sizing within marketable yield. Trends across trials point to a greater treatment impact in soils that do not have ideal conditions for maintaining P availability. CG could be an effective tool for ensuring P availability through the bulking period thereby optimizing returns, particularly on P-challenged fields.

G59

Resistance to Metalaxyl-m in Populations of the Potato Pink Rot Pathogen (*Phytophthora erythroseptica*) in Canada

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Pink rot, caused by *Phytophthora erythroseptica*, is a common disease of potatoes in Canada. Management of pink rot has relied heavily upon application of metalaxyl-m (Ridomil Gold ®), either at planting or as a foliar spray during the growing season. In recent years, isolates of *P. erythroseptica* with resistance to metalaxyl-m have been recovered in New Brunswick and Prince Edward Island. A national survey to assess the distribution of metalaxyl-m resistant strains of *P. erythroseptica* was initiated in 2013. Samples of infected tubers from across Canada were used to obtain isolates of the pathogen for subsequent testing for metalaxyl-m sensitivity using an amended agar assay. In total, 195 isolates of *P. erythroseptica* obtained from 47 individual fields or storages were tested for metalaxyl-m sensitivity. Approximately three-quarters of the isolates in the collection were sensitive to metalaxyl-m, with one-quarter of the isolates showing some level of resistance to this chemical. In general, most isolates with resistance to metalaxyl-m were recovered from eastern Canada. To date, isolates of *P. erythroseptica* with resistance to metalaxyl-m have been recovered from Prince Edward Island, Nova Scotia, New Brunswick, Ontario and Manitoba. Therefore, an expansion of the range and distribution of metalaxyl-m resistant isolates of the pink rot pathogen is occurring in Canada. The occurrence of metalaxyl-m resistance raises concerns about the efficacy of applications of Ridomil Gold ® for pink rot control and may add importance to the role played by phosphites in the management of this disease.

G60

Evidence of a Monogenic, Dominant Nature of the *Nz* Gene Conferring Resistance against *Potato virus Y* Strain Z (PVY^{Z}) in Potato

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Hypersensitive resistance (HR) to *Potato virus Y* (PVY) in potato (*Solanum tuberosum*) is controlled by strain-specific *N* genes. Two *N* genes have been identified and mapped in potato so far, *Ny* and *Nc* conferring resistance to PVY^{O} and PVY^{C} strains, respectively. A third, hypothetical gene *Nz* was proposed to confer resistance against a distinct strain PVY^{Z}. But due to the scarcity of the PVY^{Z} isolates of PVY, no formal proof of the monogenic nature of *Nz* was available until now. Here, we report on a genetic study of the *Nz* inheritance in three crosses between cultivars Maris Bard (*Ny:Nz*), King Edward (*ny:nz*), and Russet Norkotah (*ny:nz*). A fully sequenced PVY isolate, L26 representing the PVY^{Z} strain, was used to screen the parents and the progeny for the virus-induced HR phenotype in foliage. Based on the phenotypic analysis of about 200 progenies of crosses between Maris Bard and Russet Norkotah, and Maris Bard and King Edward, the segregation of HR phenotype in the PVY^{Z}-infected plants was close to 1:1, indicating a monogenic, dominant nature of the *Nz* gene. Segregation of progeny for the HR phenotype in reciprocal crosses between Maris Bard and Russet Norkotah suggested that *Nz* was a nuclear gene. Since PVY^{Z} strain comprises PVY^{NTN} isolates associated with tuber necrotic ringspot disease (PTNRD) in susceptible potato cultivars, the *Nz* gene represents a valuable source of resistance against PTNRD-inducing PVY isolates. This is the first demonstration that *Nz* is a single, dominant *N* gene in potato conferring resistance to the PVY^{Z}-NTN strain.

G61

A Multiplex IC-RT-PCR Assay Distinguishes Fourteen Strains and Recombinants of *Potato Virus Y*

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Potato virus Y (PVY) exists as a complex of nine strains and additional unclassified recombinants that vary in their genome structures, phenotypes and their economic importance. The strain/recombinant composition of PVY populations differs depending on a given geographic region and a set of predominant potato cultivars. The identification of PVY strains/recombinants prevalent in a specific potato production area is of great importance and plays a critical role in planning the PVY management program in that area. Here we report a multiplex RT-PCR assay able to detect and identify 14 strains/recombinants of PVY including PVY^{O} (both PVY^{O} and PVY^{O}-O5), PVY^{N}, PVY^{NA-N}, PVY^{Z} (syn. PVY^{NTN-A}), PVY^{E}, PVY-NE11, PVY^{N-Wi}, $PVY^{N:O}$, PVY^{NTN-B}, and PVY^{NTN-NW} (both SYR-I and SYR-II) in addition to rare types like SYR-III and 261-4. The efficiency of this multiplex RT-PCR assay was tested using well-characterized reference isolates which revealed that this multiplex RT-PCR assay is an accurate and robust method to identify these strains/recombinants. To make the multiplex RT-PCR assay more applicable and suitable for routine virus testing and typing, it was modified by replacing the conventional RNA extraction step with the immunocapture (IC) procedure. This IC-RT-PCR protocol was successfully applied to typing PVY isolates in tobacco and also in potato leaf tissue collected in the field. It was successfully used to study PVY populations in several countries with drastically different populations of PVY strains circulating in potato, including Japan and the United States.

G62

Evaluating the Effectiveness of Pesticides in Controlling Potato Psyllids

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Since Zebra Chip (ZC), a potato disease transmitted by the potato psyllids *Bactericera cockerelli* Sulc was first reported, considerable efforts have been made to control this pest. The pathogen can be inoculated by adults and nymphs, therefore controlling both life stages are critical. Whenever a pesticide treatment is needed, selection of the chemical should be consistent with the pesticide label and all state and federal laws and regulations. Moreover, effectiveness against the target organism, compatibility with the host plant, effects on beneficial organisms, degree of environmental and user safety, and cost should be taken into consideration. Thus, studies conducted at the Hermiston Agricultural Research and Extension Center in Hermiston, Oregon, will set the stage for this discussion. Potency and residual effect in efficacy trials data will be presented. There are differences among pesticides and range of effectiveness.

G63

RNA-Seq Analysis of Early Infected Potato Leaves by Potato Virus Y in Resistant and Susceptible Potato Varieties

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Potato Virus Y (PVY) is one of the most important plant viruses affecting potato production. The most efficient and cost-effective way to control PVY is planting resistant potato cultivars. Premier Russet variety is very resistant to the common strain of PVY (PVY^O), but the underlying molecular mechanism of resistance and the genes responsible remain unknown, impeding molecular breeding approaches to develop new PVY-resistant varieties. Here, we investigated and compared transcriptome dynamics by RNA-Seq in leaves of Premier Russet and Russet Burbank, a PVY-susceptible variety, 4 and 10 hours after PVY^O or mock mechanical inoculation. A total of 772 million RNA-Seq reads were generated. Around 80% of RNA-Seq reads were mapped onto the potato genome. A greater number of genes were differentially expressed (DE) ($p<0.05$) at 4 hours than at 10 hours post-inoculation (hpi), and in Russet Burbank than in Premier Russet. Two hundred seventy two genes were DE specifically in Premier Russet, and 477 were DE specifically in Russet Burbank, while 120 genes were DE in both varieties. Out of over 600 disease-resistance-annotated genes in the potato genome, a total of 18 were DE in Premier Russet and Russet Burbank. Amongst these, 7 genes were up-regulated while only one was down-regulated in Premier Russet, and only 1 was up-regulated while 11 were down-regulated in Russet Burbank. These results suggest that activation and shutdown of the defensome in Premier Russet and Russet Burbank, respectively, define resistance or susceptibility to PVY^O. These results also provide a set of gene candidates for PVY^O resistance in Premier Russet.

G64

Silver Scurf Incidence and Severity at Four Storage Temperatures

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Silver scurf, caused by *Helminthosporium solani,* produces skin blemishes that can degrade quality of stored potatoes. One recommendation for disease control is to store tubers as cool as possible, to slow silver scurf growth, without causing other tuber quality issues such as elevated reducing sugars. The objective of this study was to determine if storing naturally infected tubers at four different temperatures affects incidence and/or severity of silver scurf. Infected 'Russet Norkotah' seed lots were grown to favor elevated silver scurf infection in daughter tubers during 2010-2013. Harvested daughter tubers (15/replication, 4 replications) were randomly placed into boxes and stored at 12.8°C (55°F) and 95% RH for approximately 14 days. Temperature was then decreased 0.3°C (0.5°F) per day until the holding temperature of 4.4°C (40°F), 5.6°C (42°F), 7.2°C (45°F) or 8.9°C (48°F) was reached. All storage temperature treatments were at 95%RH and stored 3 to 6 months with independent air systems to avoid cross-contamination. Tubers were removed from storage and then microscopically evaluated for incidence and severity of silver scurf infection after a 3-week incubation period. The initial level of silver scurf infection varied from year to year, yet there were no significant differences in silver scurf incidence or severity of infection due to storage temperature for years one through three. Data from the current storage season (year 4) is not complete but will be reported. Storage temperatures between 4.4°C (40°F) and 8.9°C (48°F) had limited impact on secondary spread of silver scurf in storage.

G65

Integrating Next-Generation Sequencing and GIS Technology to Develop Bacterial Diversity Baseline Data to Evaluate Soil Health in Michigan Commercial Potato Production Systems

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Michigan (MI) ranks eighth in potato production (>$183 million) in the US. About 70% of production in MI is for chipping. A recent grower survey indicated an increase in soil-borne disease complexes and declining yield in parts of MI. Based on 12 survey respondents, 75% of growers reported that the amount of acreage affected by potato common scab (CS) caused by *Streptomyces* spp. increased by ≥11% over the last ten years. CS is a major production concern for MI commercial potato production, but the complex soil interactions related to CS severity, soil health and yield is not adequately understood. In order to better understand the soil ecology of CS 20 fields were identified for soil analyses during the fall/spring of 2012-13. A total of 20 soil samples/field (n=520) were collected and GPS marked. The bacterial 16S rRNA was targeted using next-generation sequencing, coupled with dual indexing allowing high-throughput processing of 384 soil samples simultaneously. The total number of DNA sequences identified to phyla, class, order, family and genus was 28, 81, 140, 300 and 814 respectively. Multi-layer GIS-based maps were generated from sequencing results and information gathered on tuber yield and CS pressure from each point at the end of the growing season. The results will provide baseline information on the bacterial ecology across potato production fields related to soil physical properties, soil disease disease severity and total yield.

G66

Fungicide Resistance of *Phytophthora infestans* (Mont.) de Bary, in Chapingo, México

Héctor Lozoya-Saldaña[1], Martha Nayeli Robledo Esqueda[2], and Jaime B Díaz de la Cruz[1]
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The potato late blight pathogen, *Phytophthora infestans*, is present in all the potato growing areas of México in great genetic diversity. Sexually derived progenies are common in the central highlands, where Chapingo, State of México, is located. Such diversity also includes metalaxyl resistance, which has been documented in Mexican isolates for the last twenty years. The objective of this work was to determine the levels of *in vitro* resistance of the pathogen to several fungicides from 2008 to 2012. Eighteen isolates were obtained at random from the clonal evaluation plots in 2008-2010 in Chapingo. Eleven of them (61%) were resistant and 6 (33%) showed intermediate resistance to metalaxyl. Also, four isolates were resistant (22%) and 11 intermediate (61%) to fosetil-Al. Later, plots of three susceptible varieties sprayed with half and complete dosages of fungicides were established *ex profeso* in 2011 and 2012. Foliage infection was enough to collect blight along the growing cycles in both years. Moderate to high resistance was observed for propamocarb, fosetyl-Al, metalaxil, mandipropamid, and azoxistrobin. On the other hand, the isolates were highly susceptible to ciazofamid and fluoxistrobin. The inconsistent results among the years show an unpredictable range of sensitivities. Chapingo is not a potato growing area, with no fungicide selection pressure along the years. Therefore, the *P. infestans* fungicide resistance profile found in the population under study in this location should be interpreted as a deep constitutive genetic diversity that reveals itself when selection pressure is applied.

G67

A Research Collection of Plant Pathogenic *Streptomyces*

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A collection of more than 2000 *Streptomyces* isolates has been established, preserved and partially characterized to search for pathogenicity factors and candidate gene targets for susceptibility/resistance to common scab (CS). Of more than 700 species of soil-borne *Streptomyces,* about 12 are plant pathogens, causing CS disease on potato and underground tuber and root crops. The isolates were derived from a wide range of geographic areas and potato cultivars; isolates came from tubers, the plant rhizosphere and bulk soil. The collection is annotated for species (based on 16S ribosomal RNA sequence) and presence of the *txtAB* gene encoding thaxtomin, the only known pathogenicity determinant. Most isolates (70%) have the *txtAB* operon. Many also harbor two pathogenicity factors, *nec1* and *tomA* (associated with but not required for pathogenicity). Other features genetically and physiologically haplotyped are presence and locations of repetitive sequence elements (insertion sequences) and phage integrases; secretion of hydrolytic enzymes (proteases, glycosyl hydrolases and synthases); utilization of cell wall substrates; and production/secretion of antimicrobials, characteristic of their roles as decomposers of biological materials and sources of many industrially useful antimicrobials and enzymes. Comparative genomics is being used to search for candidate gene targets for susceptibility/resistance to CS. Species with potential for biocontrol of plant disease, insects, and insect-vectored diseases have already been identified. This large diverse field collection of *Streptomyces* isolates will be a resource for studies of epidemiology, longitudinal and lateral patterns of (pathogen and biocontrol) evolution, and plant rhizosphere community interactions. Isolates from the collection are available from the author to qualified researchers.

G68

Prevalence and Prevention of *Phytophthora infestans* US-23

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Late blight, caused by *Phytophthora infestans,* is a historically infamous disease associated with the Irish Potato Famine of the 1840's and remains a devastating problem today as it continues to cause unacceptable losses on potatoes and tomatoes. In recent years, there has been an increase in the frequency of late blight in Canada and the United States, along with greater diversity of the causal pathogen. A national survey conducted in 2013 collected over 100 *P. infestans* isolates from the major potato-growing areas of Canada. The *P. infestans* genotype US-23 dominated pathogen populations from potato in most provinces and was frequently observed on garden tomatoes, thus contributing to the prevalence of the disease. Results showed that many isolates of the *P. infestans* US-23 genotype had developed resistance to the systemic fungicide metalaxyl-m and displaced other *P. infestans* genotypes within most provinces in a single season. Disease prevention strategies will need to reduce the chronic sources of inoculum produced on tomatoes through management, education, and promotion of late blight-resistant tomato cultivars such as 'Iron Lady', 'Defiant', and 'Mountain Magic'. Other *P. infestans* genotypes isolated from potato included US-8, US-11, and US-24. In some areas of the country, both A1 and A2 mating types of *P. infestans* were found in relatively close proximity, increasing the potential for sexual recombination and new genotypes with negative consequences for late blight management in Canada.

G69

DuPont™ Zorvec™ ("DPX-QGU42", "oxathiapiprolin"): The First Member of a Novel Class of Oomycete Fungicides

Shepherd, CP
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DuPont™ Zorvec™ is the global branded name for oxathiapiprolin (approved ISO common name), a novel fungicide recently discovered by DuPont and the first member of a new class of piperidinyl- thiazole- isoxazoline fungicides. It acts at a unique site of action in Oomycete pathogens. High intrinsic efficacy, an effect on all stages of pathogen development and systemic movement within the host plant allow oxathiapiprolin to provide robust and reliable disease control even under the most severe conditions. Product development is focused on crops where Oomycete pathogens limit agricultural productivity and profitability including potatoes, grapes, cucurbits and other vegetable crops. At use rates 5-100 times lower than current commercial fungicides, oxathiapirprolin is highly effective for the control of important Oomycete pathogens including *Phytophthora infestans,* causal agent of potato late blight. Its new mode of action makes oxathiapiprolin a valuable option for fungicide resistance management strategies, while safety to key beneficial organisms confer a strong fit within integrated pest management programs. A remarkably favorable toxicological and environmental profile, combined with low use rates, provides large margins of safety for consumers, agricultural workers and the environment.

G70

Monitoring Haplotypes of Potato Psyllid Collected from Potato and Bittersweet Nightshade in the Pacific Northwest

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Four haplotypes of the potato psyllid, *Bactericera cockerelli*, have been identified in the U.S. corresponding to four distinct, but overlapping regions: Central, Western, Northwestern, and Southwestern. In the Pacific Northwest, the Northwestern and Western haplotypes have been found in potatoes. The potato psyllid has also been found overwintering on bittersweet nightshade, *Solanum dulcamara*, suggesting that there is a local, cold-hardy psyllid population in this region. To understand the psyllid population dynamics throughout the summer and winter months in Washington, Oregon, and Idaho, we analyzed psyllids collected from potato and bittersweet nightshade by high resolution melting analysis to identify psyllid haplotypes over time. Psyllids collected from potato in 2012 in Washington and Oregon were predominantly the Northwestern haplotype (78%). A slight increase in the Western haplotype was observed over the growing season in the lower Columbia Basin. Contrary to this, psyllids collected from potato in south-central Idaho were predominantly of the Western population (77%). The Northwestern haplotype was found at the beginning of the season, whereas the Central haplotype was found later in the season. Psyllids collected from bittersweet nightshade in the winter of 2012 showed an overwhelming presence of the Northwestern haplotype (97%) compared to the Western haplotype (3%), suggesting that the nightshade is a suitable host for the cold-hardy Northwestern haplotype. These studies have increased our knowledge of psyllid dynamics in the Northwest, and highlight the need for biological comparisons of haplotypes to determine if different pest management strategies are necessary for control of the psyllid in each region of the Pacific Northwest.

G71

Analysis of the Prevalence and Haplotypes of *Liberibacter solanacearum*, the Causal Agent of Zebra Chip Disease, in South-Central Idaho during the 2012 and 2013 Potato Growing Seasons

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Zebra Chip (ZC) disease is caused by the bacterium *Candidatus* Liberibacter solanacearum (Lso). This bacterium, which also infects other Solanaceae species and their close relatives, is vectored by the potato psyllid, *Bactericera cockerelli*. Five haplotypes of Lso have been described, among which only 2 (A and B) have been found in potato. Both A and B haplotypes are found in North America, with regional disparities in prevalence. During the 2012 and 2013 potato growing seasons, large-scale surveys were conducted aimed at monitoring the presence of Lso in more than 1,000 psyllids tested by PCR in each season. We also performed the haplotyping of the Lso bacterium present in psyllid vectors. To haplotype the Lso bacteria, a Cleaved Amplified Polymorphic Sequences (CAPS) marker was developed based on the available sequences of the 16S/23S intergenic spacer region that discriminated A and B haplotypes of Lso. Here, we observed that while the 2012 season showed an exceptional outbreak of the disease which correlated with the presence of Lso in screened psyllids (26% of all tested psyllids), infestation prevalence in 2013 was very low (only 0.26%). Haplotyping showed that as predicted, all Lso-positive samples in 2012 belonged to the A haplotype. Interestingly, the B haplotype was detected for the first time in South-central Idaho during the 2013 season in addition to the dominant A haplotype. Since the 2013 potato production in South-central was essentially unaffected by ZC, this finding raises several questions regarding future progress of the disease.

G72

Identification of Disease Resistance Genes for Enhancement of Existing Potato Cultivars

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A plant's ability to defend itself against host-specific microbes is specified by disease resistance (*R*) genes. Upon recognition of an invading pathogen, R proteins are responsible for the activation of a multitude of responses ultimately leading to resistance. The majority of *R* genes are dominant and can be identified using germplasm screening techniques. Genes that condition resistance to many economically important potato dieseases, such as *Phytophthora infestans*, *Verticllium dahliae*, and Potato Virus Y, have been identified. Genetic markers closely associated with *R* genes are useful for breeding new cultivars with increased resistance. Equally useful is the identification and isolation of the *R* genes for use in characterization of the resistance response, precision marker development, and stable incorporation of the genes into existing popular cultivars. This talk will include an overview of research that is being directed towards the identification of major *R* genes and the prospects for their utilization in potato breeding.

G73

Assessing *Potato Virus Y* Resistance in Advanced Breeding Lines and New Cultivars from U.S. Potato Breeding Programs

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A collection of fifteen resistant and susceptible advanced breeding lines and new cultivars were obtained from nine breeding programs across the U.S. These lines/cvs were screened for resistance to *Potato virus Y* (PVY) strains (PVY^{O}, $PVY^{N:O}$, PVY^{NTN}) in Idaho, Wisconsin, and New York. These assays were conducted in the field and greenhouse in 2011 and 2012. Trials were arranged as a strip block design with three replications of the potato lines randomized within each PVY strain block (O, N:O, NTN). In the field, these strain blocks were separated by two rows of Eva, a PVY resistant cultivar, but blocks were still close enough for strain cross-contamination to occur via aphid transmission. Strain blocks were mechanically inoculated with their assigned PVY strains and symptom expression was recorded at weekly or bi-weekly intervals. A subset of entries was not mechanically inoculated, but evaluated in order to determine the resistance to virus spread by aphids under field conditions. At harvest, tubers were assessed for Potato Tuber Necrotic Ringspot Disease (PTNRD) associated with PVY necrotic strains. Tuber subsamples were saved for a post harvest grow-out evaluation to assess the amount of virus in each plot (using ELISA) and to determine the extent of cross-contamination that may have occurred (using RT-PCR). Results show that four of the fifteen entries were resistant to all three PVY strains. PTNRD symptoms were present mainly in Yukon Gold, which was used as a susceptible check for PTNRD. A comparison of strains showed that NTN source plots had a lower overall PVY incidence than the O and N:O plots.

G74

Progress toward the Development of Recombinant Inbred Lines in Potato

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Complexities due to tetraploid genetics limit breeding progress in potato. Diploids offer more simple genetics. Homozygous populations such as recombinant inbred lines are powerful resources for genetic mapping and the subsequent development of markers for marker-assisted selection. Most potato diploids are self-incompatible, but through the use of the dominant self-incompatibility inhibitor, *Sli*, we can create diploid inbred lines. We are developing sets of recombinant inbred lines (RILs) carrying genes from wild and cultivated species for improvement of tuber quality and disease resistance. Early generations (F2 and F3) are morphologically highly variable and exhibit severe inbreeding depression. Later generations (F4 and F5) are more uniform and vigorous. We are monitoring the phenotypic and genotypic effects of self-pollination to the F6 generation. Our goal is to create 100 F6 inbred lines of each of six populations. These will be shared with the research community for phenotyping and mapping.

G75

Identifying Stable Common Scab Resistant Potato Clones: A Comparison of Evaluation in Standard Breeding Trials versus Dedicated Fields

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Common scab (CS) of potato, caused by *Streptomyces scabies*, is an important disease in the US. Managing soil pH and moisture have shown to be inadequate strategies. The best option is to develop CS resistant varieties. However, CS evaluations can be complicated due to high location and season-based environmental variation for CS incidence and severity. In this study we evaluate the efficacy of CS trialing within the Wisconsin breeding program across multiple environments from 2006-13. We compared the ability to evaluate CS in a set of 18 dedicated CS trials vs 18 breeding trials with similar sets of entries (36 to160). Heritability for CS rating across dedicated trials was significantly higher than in standard breeding trials (0.83 vs. 0.53). Statistical differences between susceptible and resistant standards were only detected in dedicated trials. The dedicated CS trial results allowed us to characterize genotypic stability of CS performance across years and locations. Using results from six or more dedicated trials we identified clones with a high probability of outperforming the standards. From these analyses we found five round white clones that outperformed or matched CS tolerant Pike, eleven russet clones that outperformed or matched CS tolerant Russet Burbank and five red or yellow clones that outperformed or matched Dark Red Norland. Our results show that it is possible to select stable CS resistant clones using systematic evaluation under high disease pressure and multiple environments. Research funded in part by USDA-NIFA.

G76

Development and Application of Genome-Wide Association Studies for Autotetraploid Potato

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Genome-wide association studies (GWAS) in elite germplasm are a powerful approach to identifying quantitative trait loci (QTL) of direct relevance to breeding. A critical component of GWAS is the ability to control for population structure, which in diploid species is readily accomplished by mixed model analysis, using a random polygenic effect with covariance proportional to a marker-derived kinship (or relationship) matrix. This method can be applied to potato and other autopolyploids by "diploidizing" the marker data (i.e., by not using dosage information). We compared this baseline approach with several fully tetraploid genetic models using marker data from the SolCAP diversity panel. Results will be presented for both simulated and real potato phenotypes, including chip fry color, glucose, and tuber shape. Software for tetraploid GWAS will be made available as an R package.

G77

High Throughput Phenotyping Using an Unmanned Aerial Vehicle

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Field trials are expensive and labor-intensive to carry out. Strategies to maximize data collection from these trials will improve research efficiencies. We have purchased a small unmanned aerial vehicle (AEV) to collect digital images from field plots. The AEV is remote-controlled and can be guided to a consistent height above the field plot, where it collects an image using a camera mounted on a gimbal. We are using it in several field trials. The first one is the National Verticillium Wilt trial, in which we have identical clones planted on *Verticillium dahliae*-infested and fumigated fields. Using a thermal infra-red camera, we are comparing leaf surface temperature in the two fields as a potential measure of disease resistance. We are also using a visible light camera to measure leaf color across the season. The digital image data will be compared with data collected on the ground. The second trial is one in which a set of clones is growing in one field under standard irrigation conditions and the other set is in a field with reduced irrigation. We are comparing leaf temperature in the two fields as a measure of drought tolerance. The third project is a yield trial of a diploid segregating population. A recent study reported a negative correlation between canopy temperature and tuber yield, so we are testing that observation in our population. Finally, we are comparing visible and thermal infra-red images of early blight screening trials with data collected on the ground. AEV technology has the potential to provide extensive data sets at a low cost, with a small investment of time.

G78

Marker-Assisted Selection in Columbia Root-Knot Nematode and Potato Virus Y Resistance Breeding in Potato

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Molecular markers can be used for potato improvement through selection for favorable traits such as disease resistance. DNA markers are advantageous particularly in backcross breeding programs for tracking the resistance genes in gene pyramiding. In this study, multiple populations from the USDA Prosser potato breeding program were screened for Columbia root-knot nematode (CRKN) and Potato Virus Y (PVY) resistances using molecular markers. Three STS markers were used to track introgression of a *Meloidogyne chitwoodi* resistance gene, $R_{Mc1(blb)}$ from the wild potato species, *Solanum bulbocastanum*. The gene $Ry_{(adg)}$ from *S. tuberosum ssp. andigena* offers resistance to PVY. One molecular marker was used to screen for this PVY resistance $Ry_{(adg)}$. Marker-assisted selection (MAS) was considerable more efficient and accurate in this multi-trait selection. Unfortunately, selection of enhanced CRKN and PVY resistance frequently results in poor agronomic performance because of possible undesirable effects caused by linkage drag. Lack of diagnostic markers for complex traits holds back the broad implementation of MAS in potato breeding. In future, high-throughput genotyping and genome-wide selection will reduce the current problems of integrating MAS in conventional potato breeding and possibly break this connection due to linkage drag.

G79

Adoption of a Real-Time PCR-Based Strategy for the Quantification of *Verticillium dahliae* in Potato Stems for the Breeding of *Verticillium* Wilt Resistance at North Dakota State University

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Verticillium dahliae is the principle causal agent of the early dying syndrome and *Verticillium* wilt, which can be responsible for potato yield reductions of up to 30-50% in the United States. Quantification of *V. dahliae* DNA by real-time PCR is an efficient and effective technique for quantifying resistance to *Verticillium* wilt in a potato breeding program. We utilized a duplex real-time PCR assay using primers and probe developed from the *V.dahliae* VTP1 gene and potato actin gene as an internal control. Potato stem tissue from cultivars and advancing selections in the North Dakota State University potato breeding program grown at Inkster, ND, were tested for *V.dahliae* colonization from 2009 to 2013. The resistant cultivars Bannock Russet, Umatilla Russet and Dakota Trailblazer consistently provided low colonization values, while the susceptible cultivar Russet Norkotah provided moderate to high colonization values. The recently released cultivar Dakota Russet, reported to be resistant to *Verticillium* wilt, consistently provided low colonization values as well. Four dual-purpose russet lines bred either from GemStar Russet, reported to be resistance to *Verticillium* wilt, (AND00618-2RussY and AND99362B-1Russ) or Dakota Trailblazer (ND049423b-1Russ and ND049506B-1Russ), were consistently low in stem colonization. Two advanced chip processing lines, ND7519-1 and ND8305-1, were also consistently low in stem colonization. The coefficient of determination (R^2) for stem colonization vs. percent wilt in the field varied widely from 0.05 in 2012, to 0.65 in 2011, and were highly dependent upon environmental factors such as weather conditions and length of the growing season.

G80

A02507-2LB and A03158-2TE: Promising Breeding Clones from the Northwest (Tri-State) Potato Variety Development Program

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The Tri-State Potato Variety Development Program has identified two breeding clones, A02507-2LB and A03158-2TE, for potential release as new varieties within the next year. A02507-2LB is notable for an approximate 80% reduction in acrylamide content of its fries relative to Russet Burbank, based on data from the National Fry Processing Trial. Evaluations of fry quality for use by quick service restaurants have also been favorable with this clone having been identified for fast-track seed increase in the SCRI acrylamide reduction program. In two years of evaluations in the Western Regional Trials (WRT), A02507-2LB has displayed greater U.S. No. 1 yields in full season trials than industry standard varieties and has resistance to PVY, late blight, verticillium wilt, and early blight. A03158-2TE has displayed high total and U.S. No 1 yields in both early and full season trials of the WRT with higher ratings in taste panel evaluations than industry standard varieties. Its attractive russet skin makes it a good candidate for the fresh market. It could also be used for processing, although lower specific gravity may be limiting to its acceptance by the processing industry.

G81

Genetic Diversity and Evolution of Recombinants of *Potato Virus Y*

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Potato virus Y (PVY) exists as a complex of strains, including a growing number of recombinants. Evolution of PVY proceeds through accumulation of mutations and more rapidly through recombination, combining large sections of parental genomes, which leads to adaptation of the virus to multiple potato cultivars and a wider range of environmental conditions. The role of recombination in PVY evolution and origin of the common PVY recombinants, such as $PVY^{N:O}$, PVY^{N-Wi}, and PVY^{NTN}, were studied through whole genome sequencing of PVY genomes and subsequent recombination and phylogenetic analysis. A collection of 119 newly sequenced PVY isolates and 166 PVY genomes from the GenBank database was subjected to phylogenetic analysis, focusing on large genome sections commonly involved in recombination. Two new recombinants between PVY^{O} and PVY^{C} genomes were found. A substantial diversity was revealed within non-recombinant parental strain types PVY^{O} and PVY^{N}, with several distinct lineages identified. This diversity in the parental sequences allowed us to trace the origins and evolution of all recombinant types of PVY. $PVY^{N:O}$ strain was found monophyletic, while PVY^{N-Wi} had polyphyletic origins. New recombinants carrying segments from strains NA-N and NE-11 were identified. From the clade placement for different genome sections, it was elucidated that certain recombinant types are formed from different parental sequences and hence likely to have some selective advantages.

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Prof dr ir Anton J. Haverkort coordinates potato research projects at Plant Research International – Wageningen University and Research Centre in the Netherlands and is extra-ordinary professor of Crop and Soil Science at the University of Pretoria (South Africa).

After graduation (MSc) he worked for many years for the International Potato Centre in Turkey, Rwanda, Peru and in Tunisia to improve potato production through agronomy, breeding and crop protection. He obtained his PhD at the University of Reading (UK) on mathematical modelling of the influence of temperature and solar radiation on potato development and growth in tropical highlands.

At Wageningen University he presently coordinates research on the development of a cisgenic marker free late blight potato (www.durph.nl), he carries out research on data management (ontology) in the French fry supply chain and leads sustainable potato production projects in 8 countries on four continents aimed at the efficient use of resources (land, water, energy) and value creation through trade and processing.

He has published over 75 scientific papers, 5 books and hundreds of conference papers, book chapters, columns and articles for professional journals. He is chairman or member of various potato committees in the Netherlands dealing with seed certification and genetic modification and was secretary general of the European Association of Potato Research. He travels frequently for potato research and consultancy for the industry, and (inter)national governmental and non-governmental organizations.

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PAA VICE PRESIDENT
MIKE THORNTON

Mike is a plant physiologist working on potatoes and onions for the University of Idaho at the Parma Research and Extension Center. His potato research program focuses on stress physiology and cultural management of new varieties. He attended his first PAA meeting in Boise, ID in 1985 while employed as a Research Horticulturist at Colorado State University. He went on to get his PhD degree in 1990 at the University of Idaho, and then spent seven years at Parma as the Extension Crop Management Specialist. Prior to re-joining the University of Idaho in 2003, Mike held research positions with NatureMark Potatoes and AMVAC Chemical. Mike served on the editorial board for the American Journal of Potato Research from 1989 to 2008, including 5 years as Senior Editor for Production and Management. He has served as Chair of several sections (Physiology, Production and Management), and been active on the membership and graduate student awards committees, and served on two local arrangements committees (Idaho Falls, 1996 and Idaho Falls, 2007). Mike is currently completing a term as PAA Director and Chairs the Site Selection Committee.

2014 PAA OFFICER CANDIDATES

PAA VICE PRESIDENT
Kent McCue

Dr. Kent F. McCue is currently a Research Geneticist with the USDA-ARS Crop Improvement and Utilization Research Unit at the Western Regional Research Center in Albany, CA. He received his undergraduate degree in Biology from Harvard College in 1981, and his Ph. D. in Plant Physiology from the University of California at Davis in 1988. During his graduate research and through his postgraduate research appointments at Michigan State, the Plant Gene Expression Center and the Western Regional Research Center, he has focused on the metabolic adaptation of plants to biotic and abiotic stress.

Dr. Kent F. McCue joined the staff of the USDA-ARS Crop Improvement and Utilization Research Unit at the Western Regional Research Center here in Albany, CA as a Research Geneticist in 1998. Since that time his work has focused on the development of molecular tools for potato and fruit trees. His primary focus is on potatoes where he has identified and manipulated genes in the potato glycoalkaloid biosynthetic pathway and is currently developing technologies to combat bacterial pathogens of potatoes and citrus using potato as a model system.

He is senior or co-author of 50 scientific publications that includes 35 peer-reviewed scientific articles, 3 US patents, and 2 book chapters. His service to The Potato Association of America includes serving as Director, Secretary, Vice chair and Chair of the Physiology Section, and he currently serves as a Director of the Executive Committee and as a member of the finance and website committees.

2014 PAA OFFICER CANDIDATES

PAA DIRECTOR
Bret Nedrow

Bret A. Nedrow was born and raised on a Seed Potato farm in Eastern Idaho, specifically Ashton. Bret attended the University of Idaho in 1990. He obtained a Bachelor of Science Degree in Agribusiness Management (1994) and then continued on to the graduate program where he obtained a Master of Science degree in Agricultural Economics (1997). Bret started in PAA in 1995 and attended his first annual meeting in Bangor, Maine. The subsequent year, Bret attended the annual meeting in Idaho Falls, ID where he participated in the Graduate Student competition presenting "Benefit/Cost Analysis of Pesticide Use in The United States Fall Potato Industry". He has continued to be an active participant in PAA. Bret started his professional career with Nestlé Potato Division in Moses Lake, WA. In 2000, he continued his career in potatoes by working for the JR Simplot Company. Since then, Bret has held various positions within Simplot both in Washington and North Dakota. Currently, he is the Regional Raw Procurement Manager for JR Simplot Company in Caldwell, ID. Bret has served on the Marketing and Utilization Section, is active on the Finance Committee (2014), and a previous 3 year term as Director on the PAA Executive Board. Bret is currently Chair of the Sponsorship Committee for the Spokane Meeting LAC 2014.

2014 PAA OFFICER CANDIDATES

PAA DIRECTOR
Amy Charkowski

Amy Charkowski is an internationally recognized authority on seed potato production and certification. Since 2001, she has been the administrative director of the Wisconsin Seed Potato Certification Program (WSPCP). Approximately $220 million in US potato sales per year can be traced back to seed produced through this program. Her research is focused on early generation seed potato production and disease control in seed potatoes and her group makes a focused effort to translate the most recent research discoveries into seed potato production practices and then to document the effects of production practice changes. The Charkowski lab group and the WSPCP participated in a recent SCRI-funded project on PVY control and they helped to implement recommendations made through this project. Amy has served on the National Potato Council Plant Disease Management and Seed Certification Subcommittee and was chair or vice-chair of this subcommittee from 2004-2007.

Amy has worked on or advised for multiple international research projects focused on seed potato production, so she is familiar with the breadth of production and disease control options used in this industry. She has also been involved in developing trade policies and in re-writing regulatory policies to better serve the potato industry and help the industry continue to produce high quality seed. For her contributions to the industry, Amy has received the Wisconsin Potato and Vegetable Growers Association Research of the Year Award (2005) and the American Phytopathological Society Syngenta Award (2011). She has also been very active in The Potato Association of America's Certification Section serving in every capacity of their Executive Committee from the 2-year Director right up through the Chair of the Section.

2014 PAA OFFICER CANDIDATES

PAA DIRECTOR
Jeff Bragg

Jeff Bragg has been involved in the potato industry in varying capacities from the time he was in grade school- doing chores such as furrow irrigating with his father. He has participated hands on in every step from variety development to the consumer. This has included tissue culture, seed production, all agronomy steps, growing, marketing, international sales, program development, packaging design, warehouse management, and cold chain management. He has served on boards, which include Potato Growers of Idaho, California Research and Advisory Board, California Asparagus Commission, National Potato Council, Idaho Potato Commission, Idaho State Department of Agriculture Pesticide Licensing, North Snake River Pumpers, and the PAA. He has served in the Marketing and Utilization section of PAA for the past three years. Jeff and his wife, Sandy, were recipients of the Environmental Stewardship Award in 1999 from the National Potato Council and EPA. During a ten-year span from 2003-2013 Jeff introduced into the marketplace 14 new varieties in Idaho, which are currently in production in North America and in consumers' homes. Jeff presently is the VP of Meijer North America, Inc., representing the breeding company from Holland with the same name. Jeff is very proud to be a member of PAA and the potato family, which it represents.

2014 PAA OFFICER CANDIDATES

PAA DIRECTOR
Asunta “Susie” Thompson

Asunta (Susie) Thompson is an Associate Professor in the Department of Plant Sciences at North Dakota State University (NDSU) in Fargo, ND. She earned a BS (1983) in Agronomy and a MS (1989) in Horticulture and Forestry from NDSU. She received a Ph.D. (1998) from the University of Idaho in Plant Science. Susie grew up on a potato and small grain farm in the Red River Valley and during high school farmed with her dad, Jim, near Barnesville, MN. She is the fifth generation of potato producers in her family and she grew certified seed potatoes as part of her 4-H and FFA activities. Her love of ag research developed while an undergrad working hourly at the USDA Radiation and Metabolism Laboratory (Fargo) for a weed scientist, and beyond while working for Pioneer at their spring wheat breeding station near Glyndon, MN, where plant breeding and genetics became her penchant. She was a Research Technician on the NDSU Potato Breeding Project under Dr. Robert (Bob) Johansen (1985-1988), and a Research Associate with Dr. Stephen Love (1989-1995) at the University of Idaho Research and Extension Center, Aberdeen, ID.

Susie was a Research Horticulturalist with Colorado State University (1995-2001) at the San Luis Valley Research Center developing cultivar specific management practices for advancing selections and new releases from Dr. David Holm’s breeding program with Drs. Rob Davidson and Richard Zink. Currently, she is the potato breeder at NDSU (2001-present), where the North Dakota Agricultural Experiment Station and potato improvement team have released 6 new cultivars during her tenure, most recently, Dakota Ruby (ND8555-8R). Her research interests include sugar ends, cold sweetening, disease and pest resistance (Colorado potato beetle, late blight and Verticillium resistance to name a few), and cultural management practices.

She is a member of the NCCC215 Breeding and Genetics Project. Susie has been a member of the PAA since 1986, and has been active in the Breeding and Genetics section, Physiology section, and the Extension, Production & Management section. She was also a former Director.

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