50th Annual
Montana Seed Potato Seminar

Proceedings

Hosted by:
Manhattan Area Seed Potato Growers
In Cooperation With
Montana State University Extension Services

MONTANA
STATE UNIVERSITY
EXTENSION

November 3rd , 4th and 5th, 2015

Hilton Garden Inn
Missoula, Montana

Seminar Hosts: Manhattan Area Seed Potato Growers

Big Sky Seed

Eugene Cole Farm

Cole's Corner Farms, Inc.

Droge Farms, Inc.

Dyk Seed Potatoes, LLC.

TRB Dykema, LLC.

Foth Farms

Clark V. Johnson

Kamps Seed Farm

Kimm Brothers Farming, LLC.

Kimm Seed Potatoes

Dan Kimm Certified Seed Potatoes, LLC

Kimm's Organic Potatoes, LLC.

London Hills Farm.

Schutter Seed Farm, Inc.

Skinner Spuds

Spring Creek Farms, Inc.

Van Dyke Farms

Weidenaar Ranches, Inc.

White's Potato Farm, Inc.

Staff of Montana Seed Potato Certification

Dr. Nina Zidack, Director

Susie Siemsen, Laboratory Supervisor

Teresa Meeker, Research Assistant

Elaine Nichols, Research Assistant

Eileen Carpenter, Research Assistant

Becky Evans, Program Coordinator

Anna Jespersen, Research Assistant

Dr. Alice Pilgeram, Research Associate

Barbara Oyster, Research Assistant

Elisa Boyd, Graduate Student

PROGRAM

2015 MPIA Member's Annual Meeting and
50th Annual Seed Potato Seminar
Missoula, Montana

TUESDAY, NOVEMBER 3rd

10:00 a.m. - Research Committee Meeting

11:00 a.m. - Advisory Committee Meeting (lunch at noon)

2:00 p.m. - MPIA Board of Directors Meeting

4:00 p.m. - MPIA MEMBERS MEETING
Members Only Please

WEDNESDAY, NOVEMBER 4th

7:00 a.m. - **Continental Breakfast, Registration Open**

8:00 a.m. - The 2015 Crop	Nina Zidack
8:15 a.m. - NPC Update	Dan Lake
8:30 a.m. - Potato Leadership School	Bridgett Lake
9:45 a.m. - PVMI Update	Jeanne Debons

10:00 a.m. - **Break**

10:30 a.m. - The Positives of Passing It On - Workshop With Jolene Brown

12:30 p.m. - **Lunch**
Sponsored by United Potato Growers of America

1:30 p.m. - **Trade Show and Sponsored Presentations**

1:30 p.m. - United Potato Growers

2:00 p.m. - United States Potato Promotions Board	Blaire Richardson
2:20 p.m. - The Benefits of Priaxor on Potatoes	Jared Unverzagt, BASF
2:40 p.m. - Potato Equipment Innovation - Past, Present, and Future	Tom Tallackson, Lockwood
3:00 p.m. - Sustainability Through an AgriEdge Enabled Solution; The Answer to Whole Farm Record Keeping and Environmental Stewardship	Jill Herold, Syngenta

6:00 p.m. - **Banquet - Keynote Address "Wrinkles of Wit and Wisdom" - Jolene Brown**

PROGRAM

2015 MPIA Member's Annual Meeting and
50th Annual Seed Potato Seminar
Missoula, Montana

THURSDAY November 5th

7:00 a.m. - 8:15 a.m. Breakfast
Sponsored by Watson Irrigation

7:00 a.m. - Registration Open

8:20 a.m. - Welcome
Jack Meyer, Manhattan Area Seed Potato Growers

8:30 a.m. - Evolution of the Montana Seed Potato Certification and Improvement Programs
Mike Sun - Past Director - Montana Seed Potato Certification Program

9:00 a.m. - New Challenges in the Potato Industry
Nina Zidack - Director -Montana Seed Potato Certification Program

9:30 a.m. - In the Beginning There was Russet Burbank:
A Summary of Variety Development
Melvin Martin, Martin Potato Consulting, LLC., Moses Lake, WA

10:00 a.m. - Current Research and Future Insights in Potato Breeding and Variety Development
Rich Novy - USDA/ARS, Aberdeen, ID

10:30 a.m. - Break

11:00 a.m. - The Advances That Built the Washington Potato Industry
Robert E. Thornton - Washington State University - Retired, Pullman, WA

11:30 a.m. - Potato Agronomy - Present and Future
Mark Pavek - Washington State University, Pullman, WA

12:00 p.m. - Challenges and Advances in Potato Pathology
Walter Stevenson - University of Wisconsin - Madison - Reitred, Madison, WI

12:30 p.m. - Potato Pathology - Present and Future
Amy Charkowski - University of Wisconsin - Madison, Madison, WI

1:00 p.m. - Lunch

SPEAKER BIOGRAPHIES

Jolene Brown
Certified Public Speaker
West Branch, IA

Meet Jolene Brown, Keynote Speaker and Workshop Leader

Jolene Brown will have you laughing while you learn! She's an award winning communicator, and an honored recipient of the Certified Speaking Professional, the highest earned designation of speaking achievement worldwide! She's known as a Champion for Agriculture whether from the platform, in the magazines, on television, or on the radio.

She is a walking-talking spokesperson and consultant for the family-owned business. With her keen insight and result-centered approach, she's been invited to sit at lots of kitchen tables and family business meeting rooms. Jolene has learned what works and what doesn't. She understands the unique challenges facing parents, siblings, in-laws and "outlaws" who work together.

Jolene's new DVD and workbook set based on her popular family business workshop, "If We Huff and Puff, Will We Blow Your House Down?"™ is now for sale! In this program, you'll discover that a carefully constructed business brings a productive and profitable result. You also gain desired peace of mind, strong family relations and a solid foundation for a family business legacy.

Jolene's popular book, *Sometimes You Need More Than a 2x4!*, contains how-to-tips so those in agriculture can increase productivity, profitability and peace of mind.

As co-owner and active partner on their Eastern Iowa corn and soybean farm, her practical experience includes plugging a grain auger, hypnotizing chickens and entertaining folks behind the equipment parts counter.

Jolene cares deeply about the Ag industry and is on a mission to share leading-edge best practices. She's a passionate supporter, promoter and champion for the people who feed, clothe and fuel the world.

Her worldwide audiences appreciate her fun-filled humor and real-life stories. They leave with take home value, great big smiles on their faces and eager to return for more.

Mike K. Sun, Ph.D.
Past Director, Montana Seed Potato Certification Program
Montana State University
Bozeman, MT

1978 – 2008: Montana Seed Potato Certification and Improvement Program Director
1976 – 1977: Postdoctoral at Michigan State University on ELISA of Blueberry Shoestring virus
1975 - 1976: Postdoctoral at North Carolina State University on World Root-knot Nematode Distribution.
1973 – 1975: Plant Pathologist at Asian Vegetable Research and Development Center
1971 – 1973: Postdoctoral at North Carolina State University on Tobacco virus diseases
1967 – 1971: Graduated from North Carolina State University with a PhD degree in Plant Virology.
1965: Graduated from National Taiwan University in Plant Pathology

Nina Zidack, PH.D.
Montana State University
Bozeman, MT

I grew up on a farm/ranch on the edge of the Missouri Breaks near Winifred, MT. Through growing vegetables to sell to neighbors, I developed a love for Horticulture and went on to receive my B.S. in that field in 1987. As a Horticulture student, my favorite classes were in Plant Pathology which led me to begin graduate work at MSU. I transferred to Auburn University in 1988 and received my Ph.D. in Plant Pathology in 2003. I have served as the Director of Seed Potato Certification at Montana State University since 2008. Prior to that, I worked as a Research Professor in the Department of Plant Science and Plant Pathology at MSU and as the Plant Disease Diagnostician for the Schutter Diagnostic Lab. My responsibilities to the Montana Seed Potato Program include supervision of all field inspections, both in Montana and for the Postharvest Test in Hawaii, and the administration of activities performed by the MSU Potato Lab including maintenance of mother stock, distribution of in-vitro plant material to growers, and disease testing. In addition to the regular functions of certification, our lab is actively involved in adopting and improving on the latest diagnostic methods available for the identification of plant diseases important for certification. At the Potato Lab we currently perform over 600,000 ELISA tests during summer testing and almost half that many during winter postharvest testing. We have developed the capacity to do a significant amount of dormant tuber testing using PCR and have adopted PCR-based diagnostic assays over 20 important potato pathogens including viruses, bacteria, fungi, mycoplasmas and nematodes. We conduct research projects aimed at improving production of early generation seed potatoes and are currently exploring the differences in susceptibility to PVY of in vitro produced planting stock compared to field grown tubers.

Melvin Martin, B.S.
Martin Potato Consulting, LLC.
Moses Lake, WA

Mel was born and raised in Oregon and holds a BS in agriculture from Oregon State University (1964). He currently resides in Moses lake Washington with his wife Shawlene. Together they have 5 children, 9 grandchildren and 6 great grandchildren. Mel is currently semi-retired and is currently consulting on a part time basis.

Mel has been an essential component of the Washington and US potato industry for the past 50 years and dedicated much of his career to the potato processing industry working for Taggares, Carnation, Nestle SA, and the JR Simplot Co where he held the position of Washington Raw Procurement Manager for 32 years and 13 years as Manager of Raw Material Research for Washington. He was instrumental in the development of incentivized potato contracts and potato quality evaluation grading systems. He holds a wealth of knowledge and shares it freely among his colleagues. His expertise is vast and has afforded him global recognition, travel, and participation in many foreign projects. Besides the U.S., Mel has assisted on projects in Mexico, Canada, Poland, Chile, Argentina, China and Tasmania. Mel's contributions are tangible by-products of his passion for potatoes and the science that surrounds their production.

Mel has been instrumental in the development and naming of several potato varieties, particularly the Ranger Russet. Despite early indications of severe blackspot bruising, Mel saw the processing potential of Ranger and helped introduce this now popular variety to the industry. He has been an active participant of the Tri-State and Western Regional Potato Variety development programs since their inception. Locally Mel was an active participant on the Washington State Potato commission Research Council since it began, and was a member of the Washington State Potato Conference and trade Show committee for nearly 20 years. He was named to Honorary Life Membership in the Potato Association of America in 2007 and was inducted into the Moses Lake Chamber of Commerce Hall of Fame in 2012.

Rich Novy, Ph.D.
USDA-Agricultural Research Service
Aberdeen, ID

Rich Novy is a potato breeder/geneticist with the USDA-ARS at Aberdeen, Idaho and has been in this position since 1999. Prior to accepting his current position he was the potato breeder/geneticist at North Dakota State University, Fargo, ND. He attended Washington State University and obtained his B.S. in Horticulture and his M.S. and Ph.D. in Plant Breeding and Genetics at the University of Wisconsin-Madison. He is a member of the Northwest (Tri-State) Potato Variety Development team comprised of state and federal researchers in the states of Idaho, Oregon, and Washington and during his career has contributed to the release of 37 potato varieties. His contribution to potato variety development has been recognized with two ARS technology transfer awards, a Federal Laboratory Consortium for Technology Transfer Award from the Far West region, a USDA-NIFA Partnership Award for a SCRI grant in controlling zebra chip disease, and an Outstanding Extension Award for the storage management of new potato cultivars from the Potato Association of America. In addition, he has authored or co-authored 62 breeding and genetics publications in peer-reviewed journals and text books.

Robert E. Thornton, PH.D.
Washington State University - Retired
Pullman, WA

Education:

B.S.	General Agriculture, University of Idaho	1955
M.S.	Horticulture, University of Idaho	1957
Ph.D.	Horticulture, Washington State University	1972

Professional Experience:

1957-1960	Research Plant Breeder with Jr. Asst. Plant Pathologist rating. University of Idaho, Twin Falls, Idaho
1960-1962	Research Agronomist, J.R. Simplot Co., Food Processing Division
1962-1967	Area Extension Potato & Onion Specialist, University of Idaho Cooperative Extension Service, Caldwell, Idaho
1967-1990	Extension Horticulturist, Washington State University
1991-2004	Extension/Research Horticulturists (75/25)
2004-Present	Extension/Research Horticulturist Emeritus
1980-1981	Acting Chair - Department of Horticulture and Landscape Architecture, Washington State University
1984-2000	Co-owner Agricultural Business Consultants
2000-Present	Owner Agricultural Business Consultants
2000-2003	Partner Thornton Consulting, Inc.

Professional Membership:

Potato Association of America (PAA)
- Member (1972 to Present)
- Honorary Life Member (1988 to Present)
- Extension Section Member (1968 to Present)
- Chairman of Extension Section (1969-1971)
- Production and Management Section Committee (1970 to Present)
- Chairman of Production and Management Section (1973)
- Nomination Committee Member (1972-73, 1973-74, 1982-83)
- Graduate Student Awards Committee (1976)
- Site Selection Committee (1978-1981)
- Local Arrangements Committee-Chair (1974), Facilities and Program Chair (1991), Co-Chair (2003)
- Director (1976-79)
- Vice President (1979-1980)
- President-Elect (1980-1981)
- President (1981-1982)
- Past President (1982-1983)

Epsilon Sigma Phi - Extension Honorary (1976 to Present)
Potato Chip/Snack Food Potato Technology Advisory Committee (1978-1984)
Sigma Xi - National Research Science Honorary (1974 to Present)
European Association for Potato Research (1981 to Present)

Mark Pavek, Ph.D.
Washington State University
Pullman, WA

Mark J. Pavek is an Associate Professor in the Department of Horticulture at Washington State University in Pullman, WA, USA. Dr. Pavek is a potato specialist and conducts applied agronomic and variety development research. He uses his research results to provide outreach to the local industry, aiding in their potato production and marketing. He was born and raised within the major potato producing region of Idaho, USA and attended the University of Idaho (BS Agribusiness, BS Crop Management, MS Weed Science) and Washington State University (PhD Potato Agronomy). He has been professionally involved in the potato industry since 1990. In addition to his employment at Washington State University, he has been a commercial potato farmer in southern Idaho and employed by Zeneca (Syngenta). He was also a Research Manager for NatureMark Potatoes (Monsanto), conducting applied field research on genetically engineered potatoes.

Dr. Pavek is an active participant in the Potato Association of America and the Northwest Potato Variety Development Program which involves the University of Idaho, Oregon State University, Washington State University, and the Potato Variety Management Institute (PVMI)). He is also active in the Western US Regional Breeding Program (WERA027) and the Western US Regional Potato Virus and Virus-Like Disease Management Program (WERA089). Dr. Pavek has been an active participant in the annual National Potato Council's "D.C. Fly-In" since 2010 to better understand and advocate for the industry's most pressing federal policy priorities, including potato research. Mark enjoys spending his off-time with his wife Pamela and their family, friends and dogs.

Walter R. Stevenson, Ph.D.
University of Wisconsin - Madison - Retired
Madison, WI

Dr. Stevenson received his B.S. degree from Cornell University in 1968 and his Ph.D. degree in Plant Pathology from the University of Wisconsin-Madison in 1972. Dr. Stevenson served on the faculty of Purdue University, West Lafayette, Indiana from 1972-79 where he had statewide responsibility for working with the state's vegetable industry. In 1979, he returned to the University of Wisconsin-Madison where he served as the Vaughan-Bascom Professor of Plant Pathology and Friday Chair for Vegetable Production Research until 2008 with statewide responsibility for potato and vegetable crop diseases. His extension/research program focused on improving the management of potato and vegetable crop diseases through the development of comprehensive management systems and adoption of integrated pest management practices. He continues to work with the industry as Professor Emeritus of Plant Pathology and is an active member and Fellow of the American Phytopathological Society and an Honorary Life Member of the Potato Association of America.

Amy Charkowski, Ph.D.
University of Wisconsin - Madison
Madison, WI

I am the administrative director of the Wisconsin Seed Potato Certification Program, which has been part of the Department of Plant Pathology, College of Agricultural and Life Sciences, University of Wisconsin - Madison since 1913. The seed potato program includes a certification program and an early generation seed potato farm, known as the Lelah Starks Elite Foundation Seed Potato Farm. Approximately 7.5% of the potatoes produced in the United States can be traced back to this program. Potato (Solanum tuberosum) is an exciting and important crop to work with since it is the fourth largest food crop in the world and the leading vegetable crop in the United States. My lab group's research has close ties to seed potato certification and production.

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SPEAKER ABSTRACTS

Dr. Mike Sun

"Evolution of the Montana Seed Potato Certification and Improvement Programs."

Montana seed potato growers have constantly strived for growing the best possible quality of seed potatoes to meet the needs of the changing seed potato industry. Montana seed potato certification and improvement programs have been designed according to the grower's strive logistics.

Montana's certified seed potatoes have been able to yield well with little or no seed-borne disease to the satisfaction of the Montana seed potato users.

On the administrative side, the Montana Potato Improvement Association (MPIA) partnered with Montana State University (MSU) has been responsible for establishing Montana seed potato certification and improvement programs.

The Montana potato growers founded the MPIA to conduct self-directed seed potato certification in 1920 to combat seed-borne disease. In 1951, through legislative action, the MPIA Self-Directed Seed Certification evolved to become the official Montana Seed Potato Certification Program.

On the technical side, combating seed-borne diseases was accomplished through seed field design: it originated from the Foundation Seed Plot of 1920, evolved to the PVX-free Elite Seed Plot of 1970, to the Disease-Free Seed Plot of 1980 and then to the Limited Field Generation program of 1985.

The grower's cumulative experiences in growing potatoes coupled with MSU's high tech disease testing programs has advanced the improvement of the Montana seed potato quality.

Notes:

Dr. Nina Zidack

"Certification's Role in Addressing New Challenges in the Potato Industry."

The Montana State University Seed Potato Certification Program is responsible for all of the steps required for a potato grower to certify potatoes as seed. First, the motherstock for all of our potato varieties is tested to insure it is disease-free and then is maintained in a clean room at the Potato Lab. Second, in order for a grower to certify seed they must register each variety and field in the program. A unique element of our program is that only seed originating in Montana can be certified through our program. Certified seed from other states and Canada are not allowed to be recertified as seed in Montana. Third, our program conducts three inspections per growing season starting in early July and ending late August. We also perform extensive leaf testing on potatoes, especially at the nuclear and Generation 1 classes where all seed lots are 100% tested. All of our seed potato lots are sent to Oahu, Hawaii for postharvest testing and are 100% tested for PVY, PVX and PVA. Shipping point and phytosanitary inspections are conducted by the Montana Department of Agriculture.
As a relative newcomer to seed potato certification, I have already experienced a multitude of changes in the challenges of growing healthy seed. I started as Director in 2008, the last crop year where leaf roll was detected in Montana Seed Potatoes. Since then, we have dropped it out of our routine testing program and only perform the test for suspect plants or to meet export requirements. There have been no new detections since then. In 2007, the Potato Lab initiated a testing program for PVA based on its' identification as an emerging disease in Idaho and the Columbia Basin. Since we had never tested for PVA, early infections in nuclear and Generation 1 had gone undetected causing elevated levels in later generation seed lots. Through 100% testing of nuclear and G1 and targeted roguing, this disease has been reduced to trace levels. Due to the resurfacing of Bacterial Ring Rot in the Northwest, our lab has adopted new protocols to perform extensive testing of tubers. We now use Realtime PCR to detect ring rot as opposed to ELISA and immunofluorescence. Another area of extreme change is in the strain profile of PVY. When I started in 2008, PVY^{O} was still the dominant strain but it has been rapidly replaced by the necrotic strains $PVY^{N:O}$ $PVY^{:Wi}$, and PVY^{NTN}. This has significant implications for certification due to milder symptoms produced by these strains making visual inspections more difficult.
The Potato Lab received funding to obtain a Realtime PCR instrument in 2010 and since that time we have adopted protocols for nearly all important potato pathogens including fungi, bacteria, nematodes and viruses. With the detection sensitivity of Realtime PCR ~100 times as sensitive as ELISA, the option for dormant tuber testing has emerged as an alternative to sprout testing or testing leaves from a winter grow-out with ELISA. For the 2014 crop, we tested 7910 tubers for PVY to replace either missing PHT data, or to provide supplemental data for seed lots that were on the threshold for plant-back tolerances. The Potato Lab is collaborating with 28 potato research programs throughout the country on a 5-year Specialty Crop Research Initiative project to develop uniform tuber testing protocols that can be used for postharvest testing by all US Certification agencies. The data generated by the Montana virus testing program has the potential to provide new decision making tools for recertifying seed. We are collaborating with Chris McIntosh from the University of Idaho who will develop models to predict specific levels of virus from year to year based on virus levels from postharvest test data. He will draw on our extensive database of summer leaf testing results for both summer and postharvest testing.

Notes:

Melvin Martin

"In the Beginning There was Russet Burbank: A Summary of Variety Development over the Last 50 Years."

In the beginning there was Russet Burbank, selected by Sweet in Colorado (1914) from a field of Burbank, a white variety. It was grown in Eastern Idaho and promoted by the Idaho potato industry to become the predominant processing and baking potato used in the United States. The Russet Burbank is affected by many diseases, pathogens and physiological disorders.

The Russet Burbank was still a good processing potato with good textural qualities and processing yield of 3 inch fries, had great dormancy, stored well and was resistant to scab. It had also become the standard of the French fry industry and the major fryer's and QSR's wanted only the Russet Burbank. The potato growers recognized that if they were going to sustain the business, they had to do something about the problems of the Russet Burbank.

Research was begun in the 50's and 60's to both improve the problems with Russet Burbank and to expand breeding to develop an entirely new potato without the limiting quality factors of the Russet Burbank.

New varieties have been slow to be accepted with only a few grown on enough acreage to be competitive with Russet Burbank even though all of them are better than the King.

Requirements for a new variety to be accepted:

1. Must have a champion or a promoter from within industry.
2. Must have consumer acceptance and have a perceived or real better value
3. Must add value to the processor.
4. Must add value to the commercial and seed grower.
5. Growers must have enough cultural information to grow the variety successfully.
6. Must solve a problem that at the time of acceptance there seems to be no other solution.
7. All parties in the production chain add to their bottom line. (MAKE MONEY)

Many new varieties have failed due to a few traits that are not as good as Russet Burbank. Shepody, Ranger Russet, Umatilla and Norkotah are challenging but Russet Burbank is still King, although its market share for French fries has dropped from nearly 100% to about 45% over the last 50 years. This talk will discuss why many new varieties did not make the grade and the Ranger Russet story will be discussed in detail.

Notes:

Dr. Rich Novy

"Current Research and Future Insights in Potato Breeding and Variety Development."

There is increasing interest in the adoption of new potato varieties by all sectors of the potato industry. This increased industry interest reflects the view that new potato varieties can be a critical component in addressing production and quality issues of concern to the industry, as well as in providing new marketing opportunities in the case of specialty varieties. As an example, consumers increasingly want improved sustainable production for the food they consume—potato varieties having enhanced pest and disease resistance can aid industry in addressing consumer concerns, and can also aid growers by reducing their pesticide costs. Information will be presented on the potato breeding process, current priority areas of research in breeding, and emerging molecular technologies that hold promise in facilitating the development of potato varieties.

Notes:

Dr. Robert E. Thornton

"Factors that Helped Build the Washington Potato Industry."

A profile of the potato industry in Washington from the late 1800 through the first 15 years of 2000 based on average annual per acre yield provides a basis for identifying events and activities that have and are having an impact on the potato industry of Washington State. In 1948 the first water from Grand Coulee Dam was delivered to 119 acres of the Columbia Basin Project located near Pasco in south central Washington, by 1960 Grand Coulee Dam water was delivered to nearly 300,000 acres of the project. A major and highly significant event was the establishment of the Washington State Potato Commission (WSPC). It was established in 1956 by action of the state legislature to "provide the most efficient means of improving the quality of Washington potatoes through research and similar programs…" As a result of this initial commitment the Commission has provide nearly 20 million dollars for research and extension projects throughout it's nearly 60 years of existence. In 1962 the annual Othello Seed Lot trial was established by Washington State Collage (WSC), later Washington State University (WSU), supported by funding from the WSPC. Initially the tuber samples for these trials were collected by WSDA inspectors from potato seed lots grown in or coming into and planted in Washington. From 1978 obtaining and submitting samples for the seed lot became the responsibility of the seed receiving entity in Washington. Sample tubers are planted and grown by WSU on a university research unit. At designated intervals the individual seed lots are observed for the presence of seed borne diseases and seed associated physiological conditions. These observations (readings) are done by experienced WSC, WSDA and USDA personnel. Additional individuals including university graduate students, university faculty and staff and potato seed also utilize these trials for training. A public field day is held at which the results of the current trials are made available. Results are also available to the public by request and electronic means. During the 1970's an extensive WSU effort was directed at reducing tuber damage during harvesting and handling operations. Equipment design and management practices were evaluated and concepts to reduce tuber damage were developed. The results were adapted and are currently being utilized by the industry. Another area of concern was erratic plant population i.e. number of plants per acre needed for Washington vs those populations identified as appropriate for the industries in other potato growing areas of the US. To be able to understand the extent of the problem extensive field surveys and basic research were carried out throughout the 1960's and into the early 2000's. Initial survey results found that potato plants were not growing where a potato seed tubers or seed pieces was believed to have been planted and that the primary reason was the result of faulty seed tuber/seed piece placement not seed piece decay and blind seed pieces. These findings resulted in the initiation of research to identify the underlying cause(s). These studies found that planter design, management and operation along with design, management and operations of the seed cutting processes contributed to the problem. Further studies identified seed tuber size and shape as also having an impact on the ability to manage the cutting and planting operations to obtain the desired seed placement and plant population. Follow up field surveys document that plant population closer to those desired are now being achieved. Both of these research and educations efforts utilized the expertise of faculty from the departments of Horticulture, Agricultural Engineering and Agricultural Economics at WSU.

Notes:

Dr. Mark Pavek

“Potato Agronomy - Present and Future.”

The scientific method has grown up around the idea that progress comes from both trial and error and that the key to future success is often found in a reappraisal of the past. Scientific and engineering ingenuity have been the driving force behind the progress of the US potato industry and have afforded consumers a stable, diverse, healthy, and inexpensive food supply. Important government legislation laid the ground work that enabled researchers and engineers to discover and develop new technology, varieties, and methodology. Perhaps more important than these discoveries, was the need to transfer this information and technology directly to the people who would benefit from it. In 1862, President Lincoln and the US Congress established the USDA in conjunction with the Morrill Act, which established the nation’s network of land-grant colleges and universities. Twenty five years later, the Hatch Act directed federal funding into state agricultural experiment stations. This allowed for timely research specific to the needs of the local industries. In 1914, the Smith-Lever Act took the university and research to the people by establishing the Cooperative Extension System. The underlying premise of these acts was that a well-educated farmer is one who produces more while using less, an idea that is the forerunner of contemporary “best management practices.”

New disease-resistant varieties, high-quality disease-free seed, and improved management combined to dramatically increase potato yields while reducing the amount of land under cultivation. Over the course of the past 60 years, yields per acre have increased nearly 600 percent while the area under production has been cut nearly in half. In view of increasing competition on many fronts, American scientific and engineering ingenuity have contributed to the continuing economic viability of potato cultivation. Researchers, engineers, entrepreneurs, and others continue to develop new chemistries, techniques, and products, improving our markets, agronomy and pest and disease control. Improved understanding of basic molecular biology contributes to a deeper understanding of potato diseases, including Blight and viruses. Expanded use of DNA “fingerprinting” and genetic analysis favors improvements across a wide variety of purposes, such as enhanced and improved variety development. Ever since the 1984 introduction of the personal computer, computing and communication technologies have seen few boundaries. Digital image analysis, rapid chemical testing, satellite-guided precision agriculture and the quick dissemination and transfer of new knowledge via electronic continue to change the way we do business and research. Similar to other industries, the potato industry is constantly changing. Technology, consumer trends, local and world events, and many other factors play a role in shaping our future.

Notes:

Dr. Walter Stevenson

"Challenges and Advances in Potato Pathology."

The potato has become the 4th largest food crop in the world and is an incredibly important source of food energy and value around the globe. As a vegetatively propagated crop, however there is a high risk of transmission of vascular pathogens, including bacterial, viral and viroid pathogens from generation to generation, often leading to 100% of the progeny infected with these pathogens. Many of these pathogens can lead to significant loss in yield and quality. There is also a risk for spread of fungal and nematode pathogens, infecting or contaminating seed tubers, over long distances from one production area to another. The role of seed tubers in the growing of healthy productive crops was recognized well over one hundred years ago. W.A. Orton, a USDA plant pathologist, studied potato certification in Germany and helped to introduce concepts of "clean seed" in the U.S. In Wisconsin, growers soon established the WI Seed Potato Improvement Association in 1905 and by 1914, WI growers had developed the first official seed inspections in North America. With early program progress and success, it didn't take long for similar programs to be developed in many other states and provinces.

Seed potato improvement associations soon recognized the importance of visual inspections to remove symptomatic plants in the field and the development of technology for providing a continuous supply of pathogen-free planting materials. These grower organizations saw the need for research in the areas of improved diagnostic procedures, an understanding of the etiology and epidemiology of key pathogens, improved vector management and host resistance. They worked with university researchers and extension personnel to insure that seed potato growers benefited from new effective crop management technology to insure a steady flow of quality seed to the entire potato industry. In some states including Wisconsin, faculty at the Land Grant Universities were given administrative responsibilities for seed potato certification programs that effectively combined their research and outreach programs with administration. The result of these efforts is the elimination of plants infected with PSTVd (Potato Spindle Tuber Viroid) from North America, drastic reductions in the appearance of bacterial ring rot and potato leaf roll virus and improved management of Potato Virus Y. Currently in Wisconsin, virtually all of the low levels of certification rejections or reclassifications are due to levels of PVY above strict tolerance thresholds or grower error and not due to diseases of historical importance.

My tenure working with the potato industry has spanned about 40+ years but there has been significant progress in the management of economically important diseases during this period. Innovations such as pesticides targeted at specific pathogens, disease forecasting, greatly improved diagnostics and the wide scale adoption of comprehensive integrated pest management practices have not only improved disease control, but also enhanced the yield and quality of harvested tubers. These changes have benefited seed potato growers by enabling them to provide the highest quality of certified seed to growers producing potatoes for the processing and fresh market components of the industry.

The focus of this talk is to examine several key pathogens affecting the potato crop for changes in management that have occurred during my tenure and to look ahead at what the future might hold for new tools to help our industry. I will focus on fungal/fungal-like pathogens causing late blight and powdery scab; bacterial pathogens causing diseases such as black leg, stem rot, tuber soft rot and ring rot; plant parasitic nematodes and diseases caused by viruses and viroids. While this overview will necessarily be brief, there are many common threads. It's important to remember that each of these diseases has the potential to be national in scope and that seed potatoes can serve a vehicles for moving these pathogens to the far corners of North America and beyond. Rotation, use of pathogen-free planting materials in crop year #1 along with a limited generation production plan, visual field and bin inspections, winter testing of seed lots, bin and equipment sanitation between crops and use of integrated pest management tools in the field and storage are all designed to minimize plant infection and spread thus insuring the highest quality seed potatoes for planting. These are all tried and true recommendations used throughout the industry with success. As we look to the future, I see further refinement in our production techniques that include greater reliance on site specific pesticides. There will be improved diagnostics providing

rapid and accurate diagnosis of pathogens so that management tools can be employed in a timely manner. Since many pathogens are soil borne, we have a critical need for improved soil sampling and assays that are both accurate and cost effective. Finally I see greater emphasis on developing cultivars that are resistant to many economically important pathogens. There are already several breeding programs that have increased emphasis on disease resistance in addition to the parameters of productivity, storability and consumer preference. While traditional breeding is making slow progress toward improving disease resistance, new biotechnology efforts have the potential to move resistance genes into currently acceptable cultivars. The challenge here is not so much development of new technology, but adoption of this technology and its products by consumers, the processing industry and the restaurant trade. Given the progress made in the past 40 years, I fully expect to see a flurry of new developments in the next decade that will bring lasting solutions to age-old problems. We have to be optimistic about the promise of good science, but at the same time I'm reminded that potato late blight led to the unparalleled famine in Ireland in 1845. The last time I checked, we are still fighting late blight around the world though with better tools and much better results.

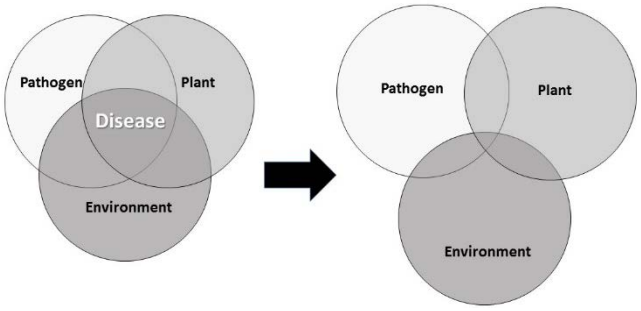
Congratulations on the 50th Anniversary of the Montana Seed Potato Seminar. In these turbulent times, anything that's lasted 50 years and contributed to an industry as important as the Montana seed potato industry deserves praise and recognition. Best wishes for another 50 years!

Notes:

Dr. Amy Charkowski

"Potato Pathology - Present and Future."

Plant Pathology is the study of the intersection of microbiology, plant science, and the environment. We often describe plant disease using a triangle or Venn diagram that describes this intersection. Disease requires a pathogen, a susceptible plant, and a conducive environment. To improve plant health and reduce disease incidence, farmers need to reduce the overlap between these three things. For example, to reduce the incidence of Potato virus Y, farmers can plant healthy seed potatoes (pathogen), they can choose resistant varieties (plant), and they can plant earlier to avoid late season aphid flights (environment). Advances in pathogen detection technologies, plant genetics and genomics, and in tools for epidemiology will likely aid farmers in disease management in the near future.



New Pathogen trade in seed over the past few numerous pests and

Detection Technologies. Increased potatoes and other planting material decades is resulting in spread of diseases. As a result, seed must undergo an ever increasing number of laboratory tests to insure that disease incidence is below certain thresholds or that particular pathogens are not likely to be present in the seed lot.

With current technology, laboratory testing is more expensive and more difficult than the visual inspections that seed potato certification has historically relied upon. It is difficult for individual seed potato certification agencies to provide all of the expertise required for the increasing number of types of tests and also to provide the required equipment for these tests. Combined with a decreasing number of university experts on each particular disease who are available to assist with pathogen testing, this will likely drive us toward either commercial or regional laboratories that provide testing for seed potato lots. In other seed potato producing countries, national laboratories are often responsible for testing seed potato lots. Growers would benefit from use of regional or national labs because it would reduce the cost of testing and allow them to access a greater level of expertise than any individual state can provide.

The technologies that may be used for pathogen detection are changing quickly and it is difficult to predict what the most common technologies will be years from now. I anticipate that full genome sequencing will be common for unusual samples and to confirm plant variety and that fast in-field methods will be used to confirm the identity of more common pest and disease problems.

Remote Sensing and Big Data for Disease Management through Understanding Epidemiology. Remote sensing may be a game-changer for seed potato certification. Technologies such as automated image analysis and reflectance spectroscopy may be developed further and these methods may allow farmers to mount imaging devices on field equipment, such as tractors, sprayer booms, or irrigation rigs or on UAVs. These devices could have the capability to collect spectral data that can be used to measure plant health and development. These measurements could be tied to location to assist with field measurement and could be analyzed with previously collected data to provide insight into expected crop performance. It is quite possible that seed potato farmers would sell these data along with their seed potato lots instead of having a third party inspection to insure seed potato health. One of the large challenges faced by agriculture today is development of simple and accessible methods for collection and analysis of field data.

Impact of Potato Genomics on Disease Management. Potato breeding has not changed substantially in the past several decades. Unlike major true seed crops, such as maize and rice, relatively little is known about the potato genome and molecular markers are just now becoming widely used by potato breeders. Similarly, little progress has been made in incorporating disease resistance into potato, perhaps because certified seed potato systems and pesticides allow farmers to effectively manage major potato diseases. A striking example of this is Potato virus Y (PVY), which is the most common reason for rejection of seed potato lots from certification. Three different PVY resistance genes are available to breeders. There are markers for all three genes and all three genes are single dominant genes, meaning that incorporation of PVY resistance into potato varieties should be relatively simple. And yet, the majority of potato varieties released over the past few years are not resistant to PVY.

The first potato genome sequence was reported only in 2010 and this and other genomic information was used to develop new tools, such as the potato SNP chip, that allow potato breeders to follow thousands of markers at once. These genomic information tools will help breeders more efficiently select for lines that have useful agronomic traits and disease resistance and should result in substantially improved potato varieties in the future. Part of the reason that potato genomics has lagged behind is that the potato genome is tetraploid, meaning that it has four copies of each of its 12 chromosomes. In contrast, tomato, which is closely related to potato, is a diploid and has only two copies of each of its chromosomes. Understanding the genetics of diploids and breeding diploid crops is far simpler than with tetraploids. There is no particular reason that farmers must grow tetraploid potatoes and diploid potato varieties are already available. In July 2015, over 50 potato scientists gathered in Madison WI to determine if potato breeding programs for diploid potato would benefit the potato industry in North America and to plan a way forward for diploid potato. The benefits of a diploid potato breeding program would include swifter progress toward improved varieties, use of traits that are not currently accessible in tetraploid lines, such as deep yellow potato flesh, and possible, simplified seed potato production systems.

The only long term solution for these diseases is development of resistant potato varieties. Breeding resistant varieties, even with modern molecular tools, is challenging. However, it is already possible to modify existing varieties to make them resistant to diseases, and in particular, to make them resistant to all potato viruses. If genetic modification become more common in food crops, I expect that seed potato production will become simpler and that losses due to viruses, including challenging soil-borne viruses, will become rare.

Summary. Advances in pathogen detection technologies, in remote sensing for crop health, and in plant disease resistance will have significant impacts on our understanding and management of plant disease in seed potatoes. We are likely to see regional laboratories manage pathogen testing, rather than state-based laboratories. We may find that growers collect and sell crop health data via remote sensing methods rather than relying on third party visual inspections by certification officials. And, we are likely to see some diseases fade in importance as transgenic or traditionally bred disease-resistant varieties are developed.

Notes:

Speaker Addresses

Mike Sun, Ph.D.
Montana State University - Past Director
3464 Sourdough Road
Bozeman, MT 59715
Cell: (406) 404-9742
Email: mikeksun@gmail.com

Nina Zidack, Ph.D.
Montana State University
Potato Certification Program Director
PO Box 172060
Bozeman, MT 29717-2060
Phone: (406) 994-3150
Fax: (406) 994-6042
Email: nzidack@montana.edu

Melvin E. Martin, B.S.
Martin Potato Consulting, LLC.
5349 Viking Rd NE
Moses Lake, WA 98837
Phone: (509) 750-2198
Email: melvin@melconsulting.com

Rich Novy, Ph.D.
Potato Geneticist/Breeder
USDA-Agricultural Research Service
1693 S. 2700 W
Aberdeen, ID 83210
Phone: (208) 397-4181
Fax: (208) 397-4311
Email: Rich.Novy@ars.udsa.gov

Robert E. Thornton, Ph.D.
Washington State University
Department of Horticulture
Professor Emeritus
Johnson C19
PO Box 646414
Pullman, WA 99164-6414
Phone: (509) 335-2989
Email: thornton@wsc.edu

Mark Pavek, Ph.D.
Washington State University
Department of Horticulture
Johnson 137a
Pullman, WA 99164-6414
Phone: (509) 335-6861
Email: mjpavek@wsu.edu

Walter R Stevenson, Ph.D.
University of Wisconsin - Madison
Department of Plant Pathology
Emeritus Professor
Russell Laboratories
1630 Linden Dr.
Madison, WI 53706
Phone: (608) 231-3163
Email: wrs@plantpath.wisc.edu

Amy Charkowski, Ph.D.
University of Wisconsin - Madison
Department of Plant Pathology
682 Russell Laboratories
1630 Linden Dr
Madison, WI 53706
Phone: (608) 262-7911
Email: acharkowski@wisc.edu

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