**Meeting Minutes**

 **WERA89 March 11-12, 2020, Best Western, Sparks NV**

**Chair**: Matthew Blua – Washington State Potato Commission

**Vice Chair:** Kasia Duellman, University of Idaho

**Secretary**: Steve Hystad, Montana State University

Attendees:

At the venue:

Matthew Blua, Teresa Almeida, Kasia Duellman, Robert Emmitt, Max Feldman, Ken Frost, Andrew Houser, Steve Hystad, Melinda Lent, Mark McGuire, Chris Mcintosh, Jeff McMorran, Sarah Noller, Julie Pasche, Alice Pilgeram, Silvia Rondon, Brian Ross, Kent Sather, Keith Schuetz, Lisa Tran, Eric Wenninger, Alan Westra, Adam Winchester, Lynn Woodell, Nina Zidack

Via internet connection:

Greg Elison, Jason Ingram, Andrew Jensen, Vamsi Nalsm, Mathuresh Singh, Kylie Swisher Grim, Johnathan Whitworth, Yuan Zeng

**Wednesday March 12, 2020**

**8:00am Call to Order**

Introductions 2020 Agenda discussion/approval 2019 Minutes approval

Alan Westra moved to approve the agenda, Kent Sather seconded the motion. The motion passes.

Alan Westra moved to approve the minutes, Kent Sather seconded the motion. The motion passes.

**8:20am State Certification Reports**

**Colorado State Seed Certification – Andrew Houser**

Since 2011 acreage entering certification and acres accepted as certified seed has been declining. In 2019, the acreage averaged around 8,000 acres, an 1800 acre decline from previous year. This decrease in acres is largely associated with PVY outbreaks. Russet Norkotah acreage is hovering around 2,000 acres, a trend from previous 5 years. Post-Harvest test plots were planted on Oct 29th. Inspections were carried out on Dec 6th. Leaf samples were shipped back to CO for the first time this year. Plots looked great, however nutsedge was problematic this year. Tagging tolerance for CO is 8% while recertification tolerance is 3%. Approximately 1,000 acres were rejected for PVY this year (split across summer and post-harvest test readings). This year 35% of CO acres was tested at 0% PVY. That is up from 25% the previous year. The average percentage of mosaic in Norkotah selections was 4.0%. Statewide average of mosaic percentage is 2.21%. CO tests every seed lot between 0-5% PVY for NTN strains. In 2019, 14% of PVY tested recorded was NTN, an 8% increase from the previous year. This year, 15 seed lots were rejected because the seed lot exceeded 1% for PVY-NTN. In 2019, a field study was carried out to determine the impact of PVY on yield. Two varieties (Canela Russet and Russet Norkotah) were planted. Initial and Final PVY inoculum levels were recorded along with yield. In Russet Norkotah, a 13.0 cwt/A yield decrease was observed for every 1% increase of PVY (initial PVY level were 1.5%; final PVY reading was 9.5%. In Canela Russet a 2.3 cwt/A yield decrease was observed for every 1% increases in PVY (initial PVY level was 0.5%)

**Idaho Crop Improvement Association (ICIA) - Alan Westra**

In 2019 approximately 30,000 (683 seed lots) acres was planted, an increase of 2.6% which is a 600 acres increase from previous years. This year there were only two lot rejections, 1 due to mosaic and 1 due to varietal mixture. Seed supplies are tight. 5-6 seed lots had blackleg but levels were below 1%. Blackleg does not appear to be an issue in Idaho. Since 2017 Idaho has been free of Bacterial Ring Rot (BRR). The lab has tested 380,000 tubers for BRR, and sampling was lower than previous years due to no positive findings. When a sample tests positive, Idaho tests sister lots and every lot that had some point of contact with the source material. Overall PVY levels are down according to PHT readings. 37% of lots were over 10%. However, the mean PVY level is 1.75% across all acres. Alan has been reviewing sampling procedures for field inspections and PHT (Post Harvest Testing). Idaho currently uses a consecutive sampling plan (200 plants per acre. Final composite sample is determined by acreage. For lots less than 5 acres, a minimum number of samples is 10 X 100 plants counted). For example, for a 38.1 acre field, the inspectors read 200 plants per acre = 7,620 plants. According to the ICIA field sampling plan, as the seed acreage decreases the chances of finding a single defective plant decreases (60% chance below 5 acres if the PVY level is 0.1%). If instead inspectors perform a 3,000 min plant count, the odds of detecting a single defective plant approach 95% if the inoculum level is 0.1%. Idaho may increase the minimum total plant count to 3,000 for seed lots between 1-5 acres. For seed lots < 1 acre, sample size will be variable. For PHT, no changes are proposed for sample sizes (400 tubers for lots representing once acre of more). Idaho currently has seed lots across locations. Some fields could be 5 miles apart and considered the same seed lot.

**Montana Seed Certification – Nina Zidack & Steve Hystad**

Montana typically plants the 3rd week of November and returns to inspect on Jan 2nd. Montana samples for PHT according to acreage and generation. 68% of seed lots tested 0 at PHT. Montana also has a significant decrease in seed lots over 2%. Average PVY levels across all seed lots was measured at 0.3% during PHT. Nina Zidack presented the proportion of seed lots destined for recertification. 75% of Russet Burbank and Ranger Russet acreage has 0% PVY after 3 generations. Umatilla, Russet Norkotah, and Alturas has less lots showing 0% at G3 but many lots in G1 and G2 are showing no PVY so futures look bright for these varieties. Steve Hystad presented results from dormant tuber testing. 121 dormant tuber samples (400 tubers) were tested for PVY and results were similar to field grow outs. Dormant tuber testing results correlate highly with field grow out results if PVY is below 3%. In seed lots above 3%, dormant tuber testing is underestimating PVY% due to an increase in false negatives. Steve is hypothesizing that for seed lots above 3% there is more current season spread and proportionally an increase in the number of tubers that have low enough virus titers that they escape detection. Steve recommends sprout testing seed lots that exceed 0.2% in summer readings.

**Nebraska Seed Certification – Adam Winchester**

In 2019, 3,400 acres were planted across the panhandle. In the sandhills (north central) region 1,959 acres were planted. In the south-central region of the state, only 453 acres were planted. Total acreage in the state was 5,845. Nebraska has around 400 acres near the south western corner near Wyoming and that acreage is expected to increase (new ground). For post-harvest testing, test plots were planted from Nov 6th – 8th. Visual readings were conducted over Dec 13th and again a month later. Plots exhibited very poor emergence. Adam suggested that it could be attributed to the use bromoethane. Once seed lots were established, only a single lot failed to meet tolerance (tolerance is 2%). PVY pressure in Nebraska is low historically. Nebraska will reduce the portion of seed lots sent to Hawaii and instead rely on sprout testing.

**Kent Sather – North Dakota**

Early generation seed growers are concentrated in Cando and Grenora. There are many acres of commercial production acreage next to seed lots in the red river valley. Acreage of seed has been decreasing over the last 4 years. In 2019, 13,461 acres were accepted as certified seed, and a few hundred acres were rejected due to PVY. PHT takes place in Homestead, FL. Due to an abundance of moisture at the end of the growing season, over 17% of seed was left in the ground. There is no tagging tolerance in ND. Only 25% of seed lots were free of PVY in 2019. This has been steadily decreasing since 2015. Of the seed lots entering seed certification just 59% of acres passed recertification (0.5% or less).

**Jeff McMoran – Oregon**

In 2019, Oregon had approximately 3,000 acres of seed production. Several lots were withdrawn for varietal mixture. Most of the seed production is passthrough (G2 - G4). In general, PVY was low according to PHT. Most of the strains reported in Oregon were Wilga (90%) (10% NTN). No PVY-O found. All PHT is from sprout tissue from greenhouse grow outs.

**10:20am Systems Based Approaches to PVY – Vamsi Nalsam, Stewart Gray, and Amy Charkowski**

Vamsi Nalsam presented research on three major tuber-necrotic viruses (PVY, PMTV, TRV). PVY is transmitted by 65 species of aphids (including hemp and cannabis aphid).

A state survey distributed to 330 seed and commercial potato growers in Colorado was recently assessed. The findings of the survey were summarized:

1. PVY was identified as the most serious disease affecting potato.

2. Growers want dormant tuber testing to help ID problematic lots earlier. However, growers are unsure if the data is helpful.

3. There is a desire among the industry to have more regional labs, operating in a high-throughput manner with results reported as pass/fail.

Solutions to PVY was discussed in the context of breeding. Breeding resistance genes into germplasm takes time, but recent identification of the RYsto gene has provided breeders a specific target for marker assisted selection or for Crispr/CAS9 systems. The efficacy of agronomic tools used to protect the crop was also discussed. Future studies on the use of crop oils + immune system inducers need to be studied to determine efficacy and cost effectiveness. Work on aphid stylet blockers need to be elucidated as well.

**Q)** How efficacious is mineral oil?

**A)** There have been lots of anecdotal (non-published) data on mineral oil applications (every 5 days). Mathuresh Singh commented that in New Brunswick, they recommend a combined use of insecticide and mineral oil to prevent PVY spread (12-13 applications per season beginning 2-3 weeks after emergence). CSS farms also use border crops (Sudan grass) to “clean” stylets of infectious aphids before they move into potatoes.

**10:50am PVY/Vector relations – Eric Wenninger**

This presentation focused on how aphids find their host plants. Initially aphid life history was discussed. Sexual reproduction occurs on some form of perennial plant (i.e. *Prunus* trees for *Myzus persicae*). They overwinter in the egg stage and emerge as wingless aphids. Eventually asexual colonies on *Prunus* species produce winged aphids that spread and feed on summer hosts. Most aphid species specialize on one or a few closely related species as stylet length matches the depth of phloem and have other means to overcome plant-host defenses. In the past aphids have been characterized as “aerial plankton” to denote that aphids fly aimlessly. However, we know that aphids employ olfactory, gustatory, and visual cues to identify hosts.

Olfactory cues –many plants produce similar volatile compounds. Aphids likely recognize host from non-host based on certain ratios of volatile compounds or when a single compound is present/absent from this ratio (i.e. onions have specific volatiles not found in wheat).

Visual – Most aphids prefer yellow (greener, less blue). In addition, the color contrast between green hosts and the background of brown soil is thought to facilitate host detection, but rigorous experiments on visual cues is limited. How can we apply this knowledge to develop management tools? Monitoring traps, manipulation of leaf colors, and manipulation of background could be areas of future research. Spraying foliage with material that alters visual appearance (kaolin, colored sprays) has been attempted but no significant success has been shown with this approach. UV reflective mulches seem to reduce the number of aphids settling on the plant. Intercropping could impact visual cues or volatiles.

Rogueing plants is effective at removing infected plants from the field; however, it leaves large gaps in the field that could result in increased visual contrast of remaining plants with the soil that attract aphid vectors. There are published reports that PVY incidence is higher around larger stand gaps. Early planting = early row closure = less contrast. After landing, aphids probe and “spit” to imbibe and “taste” dissolved surface molecules with chemoreceptors, however its unclear how this impacts feeding. Future work should examine olfaction-based management such as attractants, border crops, repellants. Vision-based management such as mulches and green/brown management and host acceptance-based management such as making host plants unpalatable during pre-probing should also be assessed.

Q. What is the purpose of the traps in managing aphids.

A. Aphid traps should be used to determine landing rates to see if your treatments are effective.

Q. What is the efficacy of BASF aphid olfactory sensor disruptors

A. A study is currently underway.

**1:20pm Testing Tubers for PVY – Jason Ingram**

Jason has been conducting dormant tuber testing for PVY. Tubers were sampled by taking a 2mm biopsy core from 4 locations across the tuber (stem, heel, two eyes). Cores were pressed onto an FTA card and dried. Punches from each FTA core are combined (25 sample composites) and processed by a Kingfisher robotic RNA extraction protocol that uses magnetic beads. Of the viruses assayed PMTV was most often located in the boot, PVY boot and rose, TRV rose end. We know virus is not distributed evenly in the tubers which contributes to unreliable detection of TRV and PMTV. The approach is effective in detecting PVY however, false negative rates increase as disease abundance increases. There is a concern in contaminating paper with the punching devices. Overall the cost savings of this test is realized by testing for multiple pathogens and if labor costs can be paid for by growers.

**2:00pm Beans are evil, Potatoes are the root of all evil - Jonathan Whitworth**

PVA was first detected in 1996 in ID but is now not an issue. The Aberdeen potato breeding program uses ELISA testing with melon baller sampling and indexing to detect virus. In their isolated seed increase, there is between 6-8% escape from their isolated plots (12 miles from nearest potato plots).

**2:20pm Powdery scab / Mop-Top – Yuan Zeng**

The life cycle of *Spongospora subterranea* was reviewed. In 2017 and 2018 two Russets, yellow, and red skin varieties were planted in naturally infested soils. There was little to no disease symptoms in russet cultivars. The chemicals Omega and Ridez did not reduce powdery scab incidence.

Counts of pre-harvest inoculum in the soil profile was performed. Sporosori did not correlate to PMTV development. Soil inoculum increased even when no or low tuber disease occurred. Powdery scab occurrence was driven by irrigation. However, irrigation was not a main contributor for increase in soil inoculation. In a greenhouse experiment, potting soils were inoculated with sporosori. Soil type affects powdery scab disease development.

Future work is aimed at examining current crop production practices in the San Luis valley and its influence on soil inoculum, powdery scab development, and PMTV incidence. This summer (2020) soil moisture and temperature will be measured by remote sensors deployed into the field to monitor and develop a disease forecasting model for powdery scab. In 2018, we recorded incidences of PMTV and powdery scab at various farms in the San Luis Valley. On one farm, PMTV incidence without powdery scab ranged from 0 – 86.7% among fields. There was no correlation between Powdery scab and PMTV. On another farm 100% of tubers tested positive for both powdery scab and PMTV. It is unclear if soil texture or pH play an important role driving progression of PMTV or powdery scab.

**2:50pm Exploring tobacco rattle virus insensitivity differences between ND and WA - Kylie Swisher-Grimm**

Russet varieties Castle and Payette were identified as less sensitive to TRV than other russets. Factors that influence insensitivity to TRV include the virus isolate, nematode abundance, and soil type. There is low genetic diversity to the US isolates. Sequence divergent analyses and phylogenetic analyses revealed that there is little variation among WA and ND populations of stubby root nematodes. In greenhouse experiments over 300 plants (russet Burbank, tobacco, Payette, and Castle russet) were inoculated with stubby root nematodes. After plants senesce, soil, roots, tubers, and foliage were collected and tested for TRV using RT-qPCR. Visual symptoms of corky ringspot disease were noted. Tobacco plants were transplanted into pots after potatoes were harvested, and symptom expression was used to confirm infection of study root nematode and TRV. WA stubby root nematode counts were higher than ND across tobacco, Russet Burbank, Payette, and Castle Russet. This could be due to the fact the ND stubby root nematodes were collected from field samples and not “seasoned” in the greenhouse. Russet Burbank had 40-50% of tubers infected with TRV. Payette tested positive for 10-20% TRV. Castle was insensitive. There were distinguishing corky ringspot syptoms in Payette. This experiment will be repeated next year. Field collected samples of stubby root nematode and TRV will used as well. Max Feldman states you can clear TRV from the soil by planting alfalfa and insensitive varieties.

**3:10 TRV and PMTV – Lynn Woodell**

Control measures of TRV include rotating into alfalfa, managing nightshade, clean seed use, and sanitation. Discussion addressed symptom development, early plant infection, higher soil moisture, later harvest, larger tubers. Tubers were evaluated at planting, mid-storage, and post storage. In 2015, symptoms were strongly expressed after storage. In 2016, there were no significant difference in symptom expression after storage. In 2017, Payette exhibited moderate symptoms, while Russet Burbank exhibited more symptoms. No apparent effect on fry color was observed unless symptoms of corky ringspot were present. Season will impact symptoms, there is potential for symptoms to increase in storage, but it varies from season to season.

**3:20pm Break**

**3:45 Identification of Genetic Resistance to PVY and Incorporated of Traits into Breeding Lines.**

Since 2012 marker assisted selection was used to get PVY-resistance genes (RY sto, adg, cho ) into breeding lines. Payette and Castle Russet have RYsto. All genes have been mapped to 1cm (1mbp) into respective markers. Except for RYsto we do not know what RYcho and RYagn really do. There are literally 100’s of genes in that space. We would like to use Crispr to knock candidate genes out. Now that the Rysto gene has been identified we can examine the relationship between resistant and nonresistant alleles. This will allow breeders to develop more reliable markers.

**3:50pm Cultivar Development – Max Feldman**

Broader breeding objectives include developing markers for necrotic viruses and cloning one PVY gene. Castle Russet has resistance to PMTV, TRV, and PVY. We have crossed castle with a susceptible variety and identified markers associated with these traits. PMTV resistance in castle Russet is polygenic (3-5 loci). Corky ringspot resistance segregates as a single loci trait. US seed potato GenBank will be screened for PMTV resistance by a single dominant locus. The focus will be evaluating wild solanum species that can cross with potato. Greenhouse experiments in which the pots were inoculated with stubby root nematodes showed that Castle russet and alfalfa were poor hosts. A mapping study is underway to examine genes that potentially confer resistance to spongospora. In addition, our goal is to clone the RY-adg gene. RenSeq will be used to identify R genes and we will use long read PacBio sequencing to identify NBS-LRR genes.

**4:20pm Value of Seed Certification – Chris McIntosh & Kate Fuller**

Estimates of PVY spread over the growing season can be as high as 10x. Loss estimates have been recorded as high as 80%. Montana has a good historical data set of current seasons (summer ELISA) and postharvest test results. PVY is perceived as less important to commercial growers than it had been in the past. Data on prices and production are readily available from existing economic models for PVY in Idaho commercial potato production. The focus here is to calculate the benefit provided by the Montana seed certification system in terms of reducing disease incidence in potato production in Idaho. Five-year average (2012-2016) acreage planted in Idaho is 326,000 1/3 planted were from MT sourced seed. 3,811 complete observations on summer and postharvest tests. Minimum sample size for PHT is 400 tubers with a maximum of 1200 acres per seed lot. Data is winsorized to remove extreme outliers. An important finding in these data is that the percentage of summer PVY positives is a significant factor in PHT readings at the 0.05 level. This tells us that if there is any virus in the seed, it will spread. Average incidence is 0.058% and without screening for PVY we would reach 100% infection in 11 seasons, all things held constant. The range of seasonal spread is from 1.9 to 9.5%. Preferred model of spread is 4.2. So, in other words, if we quit screening for PVY, we would hit 100% in 3 – 4 years. With this information we can predict PVY for seed under tolerance vs total sample. If 4.2 is the factor of spread, the cost of certification to Idaho with MT seed is about $1/acre. Without MT certification the cost per acre rises to $205/acre. This is less than the estimates from similar studies. Farm identification, year, variety, and county are significant explanatory variables. Seed Certification provides a tangible benefit that far exceeds the cost of the program.

**4:50pm Administrative Advisor Report – Mark McGuire**

The good news is that the group is very productive. The annual report is due in 60 days. The bad news, is that the WERA89 end date is a year from the due date of the annual report. We need to put together a committee to re-write the project.

**5:00pm Reception**

**Thursday March 12, 2020**

**8:00am Call to Order, Election of Secretary, Impact Statement, publications from 2019**

Max Feldman was nominated for WERA89 Secretary and there were no other nominations. Max was unanimously voted to be Secretary.

Impact Statement will be drafted by WERA89 officers

Publications as each station turns in their annual station reports.

**9:00am Grant Opportunities – Andy Jensen**

There are a broad variety of funding opportunities. Commodity commissions, boards and associations, USDA ARS/state federal partnerships, SCBG, USDA-NIFA (AFRI), USDA-SCRI. For commodity commissions dollar requests are typically small, are frequently renewed annually for 3-4 years per project, and the rate of success in getting a grant funded is high. They are particularly useful for generating preliminary data for other, larger grants from national programs. Commission funding can help make one a known and valued partner with industry. It is important for a principal investigator to show what they have accomplished and not work on a project endlessly. USDA state partnership grants are a similar category of grants (small dollar, short funding), and require ARS & non-ARS partnership. The success rate is high, but timing of the RFP is highly variable . Official reviewers are all growers, but they get assistance from commission staff and grower colleagues. The SCBG program is managed by the state but it is federal money. Each state handles them differently. In WA the grant is for as long as 3 years and is limited to $250K. The success rate is moderate. Reviewers vary by state (state employees, scientific peers, etc.). USDA AFRI is an umbrella for many programs, the success rate is low (<10%) and grants are usually for $500K for 3 years. The NIFA commodity board co-funding program allows a commodity board to develop a research topic and if NIFA approves it they match the commodity board’s investment. Revision and resubmission seem to pay off. USDA-SCRI is a program that provides multi-million-dollar grants lasting 4 or 5 years. A concept proposal is required, and stakeholder relevancy is crucial. In the potato world it’s a political game. Success rate off full proposals is quite high. Potatoes USA formed a committee to screen and force potatoes work on national programs, yet many problems are regional in scope and not national, and one needs to get Potatoes USA’s blessing. These proposals need to be reviewed by industry members.

General Advice: Plan and follow instructions. Remember who the audience is. Get to the point quickly and avoid acronyms, bland presumptuous statements, and exaggeration. Ask for reviews of the drafts. The first paragraph of a proposal should interest reviewers and get straight to the point. A well written proposal should tell a story like a good novel that pulls its readers in. One should outline research needs and objectives before assembling group of PI’s. For a letter of support plan and submit a near final draft to the letter writer. A request should include the title, RFP, brief explanation of the proposed work in the body of the message, a clear request for a support letter and to whom the letter should be addressed and to whom it should be sent.

Stewart, Nina, Amy, and Russ Groves and been involved in an ARS state and federal partnership programs. Montana’s role has been to examine factors that influence detection of PVY. Rindite did not appear influence accurate detection of PVY. For seed lots that are high PVY (6-7%), dormant tuber testing will result in many false negatives.

**Other Discussion**

Location suggested for next WERA meeting.

San Diego

Denver

Coeur d'alene

**10:00am Small Group Brainstorming Discussions**

**11:30am Group Brainstorming Discussion 3-5 minute reports**

**WERA89 roundtable on PVY:**

Dormant tuber testing can be very useful in detecting PVY in seed lots that have exhibited low levels of infection throughout the growing season. Seed lots that have a high abundance of PVY have a higher likelihood of exhibiting current season infection. Virus titers may be lower in seed lots that have current season infection.

For seed lots that have exhibited high PVY abundance, dormant tuber testing will greatly underestimate the PVY%. Testing tubers could still be an option, but we need to elucidate the relationship between dormancy, variety, and disease abundance.

**WERA89 Roundtable on PMTV vectored by Spongospora subeterranea:**

Spongospora and PMTV with continue to increase in potato growing areas throughout the US. Soilborne diseases cannot be effectively incorporated into seed potato certification rules and regulations

The group recognized a knowledge gap among those present about whether there is empirical evidence that planting PMTV infected potatoes into Ss infected soil result in viruliferous Ss.  They concurred that while survey of seed fields may be important, it was also very important to determine presence of viruliferous Ss in commercial fields.  It was agreed that seed certification needs to develop an SOP for testing for PMTV in tubers.  There is a possibility that that effort may be funded by the current SCRI that was submitted at the time our group was meeting for WERA89.  An idea that came out of the group was that if PMTV testing was implemented, seed growers could use PMTV status as a marketing tool.

**12:00pm Lunch on your own**.

The conference room will be available for planning meetings until 5:00pm.