PSPP - Plant Science Says *August, 2019*

American Society of Horticultural Science annual meeting
By Mac Burgess, Assistant Professor

From July 22-24 I attended the American Society of Horticultural Science (ASHS) annual meeting in Las Vegas, NV. I presented a poster showcasing PSPP MS Student Durc Setzer's work with Zach Miller at WARC and Heather Estrada at Flathead Valley Community College (FVCC) on new small fruit suitable for Montana's climate and soils. We are evaluating numerous improved cultivars of Haskap, Black Currant, Dwarf Sour Cherry, Aronia, and Saskatoon. There was great interest in our work at the ASHS meeting. For me, the most interesting presentations at this meeting were some of the presentations on blueberries. While mechanized harvest has revolutionized production of blueberries destined for your freezer, there is considerable growth in the market for fresh market blueberries, and most of these are harvested by hand in Oregon, Washington, and Georgia. Scientists in Wyoming and Kansas are working on indoor hydroponic blueberry production so that shorter distribution distances might help improve quality. I also learned about research in mechanized harvesting where a device called the BIRD (Blueberry Impact Recording Device) is being used to figure out where in the harvesting and sorting process berries are subjected to forces that cause bruising.

Mac Burgess at the Red Rock Canyon National Conservation Area.

It was great to return to my childhood home of Las Vegas and take some of my Horticulture colleagues on a hike in Red Rock Canyon National Conservation Area.

2019 Aquatic Plant Management Society
By Greg Chorak, PhD Grad Student and Ryan Thum, Assistant Professor

The vision of the Aquatic Plant Management Society is to be the leading international organization for scientific information on aquatic plant and algae management, and

its mission is to provide a forum for the discovery and dissemination of scientific information that advances aquatic plant and algae management policy and practice. The society is international in scope and includes scientists, educators, students, aquatic plant management practitioners, government administrators, and concerned individuals interested in the management and study of aquatic plants.

The annual conference for the Society is the main event contributing to fulfilling the vision of the Aquatic Plant Management Society. The 59th annual conference was held this year in San Diego, CA from July 14-17. Dr. Ryan Thum and his graduate student, Greg Chorak, attended and presented at the conference.

Thum presented a collaborative paper titled, "Spatial and Temporal Patterns of Genetic Variation in Lakes with Eurasian and Hybrid Watermilfoil in the Upper Midwest". Thum was a coauthor on two other talks and a poster at the conference.

Chorak presented a paper on his dissertation work titled, "Identifying gene expression differences to improve adaptive management outcomes of watermilfoil". The work is funded in part by a Graduate Research Fellowship awarded by the Aquatic Plant Management Society that Thum and Chorak were awarded one year prior. This award was renamed this year in honor of Dr. Michael D. Netherland.

A key event at the meeting was a special session in memory of Dr. Michael D. Netherland, who passed away in October of 2018. Dr. Netherland was a highly impactful researcher of aquatic plant management, and he had a tremendous impact on the Society. Thum was fortunate enough to work closely with Dr. Netherland the past several years, and was honored to speak at the memorial session about Dr. Netherland's professional and personal impacts on 'younger' aquatic plant management scientists.

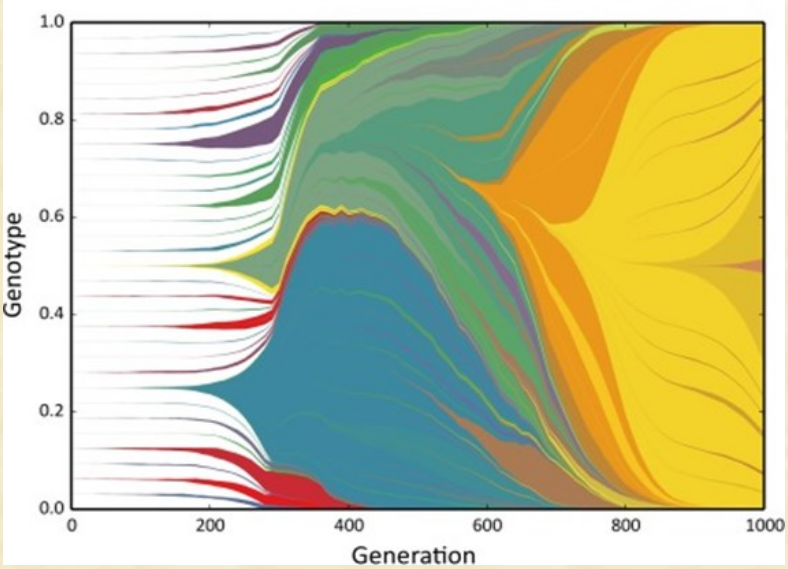
The Society is very student focused and has a group of excited young scientists that they provide travel support to so they can attend the meetings each year. The conference started with an opening night mixer for students where Greg was able to interact with students working on similar projects from around the country. Mid-conference there was a student lunch focused on exposing students to the potential types of jobs and careers that they could obtain after graduating.

During the meeting, Thum was nominated for and elected to the Board of Directors for the Society on the "Presidential Cycle". The cycle is a four year term on the Board: 1) Vice President, 2) President Elect, 3) President, and 4) Past President. Specific duties accompany each year of the cycle. Thum is honored to be elected as an officer on the Board, and is looking forward to the challenges and opportunities that come along with the associated duties.

Exploring San Diego outside of the conference was fun and entertaining. Of course, when in San Diego for the first time, going to the Zoo is a no-brainer. Thum and Chorak were amazed by the facilities and exhibits, and – even though they consider themselves pretty good naturalists – discovered several creatures that they didn't know existed. A trip to La Jolla Cove produced some sea lions and harbor seals. And, the conference dates were surrounded on one side by San Diego Pride, and on the other by Comic-Con. So, the city and the hotel – which hosted several large events for Pride and Comic-Con – were hopping the entire week, to put it mildly.

2019 Molecular Mechanisms in Evolution Gordon Research Gordan
By Jennifer Lachowiec, Asst. Professor
From June 9-14, I attended the fourth Molecular Mechanisms in Evolution Gordon Research Conference at Stonehill College in Easton Massachusetts.

I have attended this meeting three times and was chair of the early career Gordon Research Seminar in 2017, reflecting how



Visualization of genotype proportion during an experimental evolution of yeast. From Cvijovic et al 2018.

this meeting is one of my favorites. Gordon Conferences are small, up to 200 people, and generally held at uninteresting locations to keep you trapped with your fellow scientists for nearly six days. The major benefits of these meetings are the extensive time that you have to visit every poster, hear every talk, chat up potential collaborators, and reconnect with old friends.

The first major topic of the conference was breakthroughs in experimental evolution in microbes—essentially, approaches to watching evolution occur. Tweaks to next-generation sequencing technologies are enabling folks to track genotypes throughout populations of millions of cells over time. This allows detailed visualizations of the evolution process, including selective sweeps moving through a population and fluctuations in allele frequencies when multiple microbial populations coexist.

The next topic was exploring the types of mutations that generally enable adaptation to new environments. Interestingly, the phenomenon observed repeatedly is that genomes undergo fairly large duplications and aneuploidies to initially deal with stresses. After this period of genome instability, smaller scale compensatory mutations occur, increasing in frequency, allowing the initially beneficial large-scale mutations to be removed from the population. All of these observations were made in microbes again, so I wonder about the roles of these types of mutations in plants, such as susceptible weeds exposed to an herbicide or hybridization between plant species.

Finally, the aspect of the conference that I contribute to is understanding molecular mechanisms that affect evolutionary processes. I shared my lab's work identifying genetic variation dependent on the Heat Shock Protein 90 (HSP90). I shared how there is natural variation in HSP90 itself in plants that might influence how evolution proceeds. Related work shared how the speed of the ribosome on an mRNA or the positioning of an intron influences what mutations are tolerated.

I look forward to the 2021 meeting. Hopefully, with improved technologies, more people studying multicellular organisms (especially plants!) will share their understanding of molecular processes in evolution.

Organic Soil Amendments for High Tunnels
By Mac Burgess, Assistant Professor

PSPP PhD Graduate Student Charlie Watt presented an introduction to his project investigating different soil amendments in organic high tunnel vegetable production at the Western Agriculture Research Center field Day on July 25 in Corvallis Montana. Charlie did a demonstration with a physical display of the quantities of various soil amendments that would all supply the same amounts of nitrogen, but vary in their carbon content and therefore C:N ratio. C:N ratio regulates the rate at which nitrogen will be

mineralized from these amendments and how different carbon contents affect long term effects on soil quality. Charlie is interested in how to design physical demonstrations like this to help students and producers better understand how to choose soil amendment products and application rates.

Barley Genetics and Malt Quality Lab Update
By: Hannah Turner, Manager of the Barley Breeding Lab

We have been pretty busy this summer with multiple events that have both put our work out to the world and brought the region in for education!

At the end of June I traveled to New Orleans for the annual ASBC (American Society of Brewing Chemists) conference to present our research *The Effect of Steeping Regime on Barley Malt Quality and its Impacts on Breeding Program Selection*, which is important work informing our understanding of how modification in malt occurs and specifically how this plays into the current state of selection in breeding programs across the country. This was my first time attending the ASBC conference and based on the new ideas and connections I came away with, I hope to make it a regular event!

In mid-July, we hosted a Brewers Association class, The Basics of Beer Quality, which brought in 30 brewers from around the state and beyond. The full day class offered both lecture and hands on learning, teaching brewers lab techniques such as yeast counts, plating and culturing for detection of microorganisms in their process, and measuring wort gravity with instruments such as refractometers and densitometers.

This year at the Post Farm Field Day, we offered a multi-station opportunity to learn about our current research and techniques. Jamie Sherman introduced the program and our newest barley release Buzz (a malt variety with stability across environments

Brewers attending the Basics of Brewing Quality class came to MSU for the full day hands on event teaching about various techniques to incorporate in their quality programs.

The Barley Team's multi station demo at the Post Farm field day taught about our current research techniques from root structure and drone flights to malt quality and wort tast-

for low protein) and students demonstrated their work – Jessica Williams and Traci Hoogland showed how we are expanding our research view both into the soil to evaluate barley root structure and into the air to collect drone data. Joe Jensen presented some of his work looking at the genetics of Malt Quality, and I offered a wort tasting of 13 barleys with unique

chemical profiles demonstrating how malt flavor differences originate with variety.

Upcoming events include a talk on the importance of barley variety and malting process on flavor at the MT Brewers Association meeting (September 13th) and a feature on Buzz at the Celebrate Ag weekend (November 1st and 2nd).

If you are interested in learning more about the barley breeding program or the malt lab, be sure to reach out, check out our website at montana.edu/barley breeding, or find us on Instagram and Facebook!

2019 Mill & Bake Contest - Central Montana Fair - Lewistown, MT

By Deanna Nash, Jeannie Gripentrog, Harvey TeSlaa and I traveled to the Lewistown Central Montana Fair to judge the Mill & Bake Contest. The Mill & Bake Contest is sponsored by the Montana Wheat and Barley Committee (MWBC), the Central Montana Fair board and supported by local elevators and Montana Wheat Producers. Forty-one wheat samples were entered into the contest by local wheat farmers

Montana Central Fair Mill & Bake Contest - Harvey TeSlaa and Jeannie Gripentrog, Research Assistants in the Cereal quality Lab.

and we had only six days to mill them, bake them and determine whose wheat made the best loaf of bread. Criteria for the assessment included; test weight, wheat protein %, flour milling yield %, mixing type & tolerance, bake water absorption %, bake mix time, bake loaf volume and interior crumb grain. Prizes for the best entry were provided by the MWBC along with all the bragging rights that go with it. The top three winter wheat varieties and all the bragging rights go to the following producers. First place goes to Dave Linker from Denton, MT Variety WB4623. The second and third place winners both submitted the variety Northern. Second place went to Ray Linhart from Lewistown, MT and third place went to Kevin Taylor from Stanford, MT.

Western Ag Research Center (WARC) Field day Corvallis, MT

By Deanna Nash

Jeannie Gripentrog, Harvey TeSlaa, and I attended the WARC field day July 25th in Corvallis, MT. We were welcomed by the College of Agriculture Dean, Dr. Sreekala Bajwa and the WARC Superintendent, Dr. Zach Miller. Dinner and field & orchard tours followed.

Dinner showcased Montana agriculture by serving up burgers from Hamilton Packing, buns by Wheat Montana, fresh vegetables & edible flowers by Sweet Root and Mill Crick Farms, lentils from Timeless Seeds and fresh pesto using ricotta cheese from Tucker Family Farm. This was followed by specialty ice cream from Missoula's Big Dipper Ice Cream using Haskap/Honeyberries harvested at the research station. Local value-added producers featured mead, hard cider, wine, syrups and jam made from locally sourced fruits and berries. Yum.

The station tours highlighted cold hardy grapes, cider apple varieties, cold-hardy berries, vegetable, forage and pulse crop

Bridgid Jarrett - Berry Coordinator, Western Ag Research Center (WARC) Corvallis, MT 2019 Field day featuring Honeyberries.

production and integrated livestock and weed management. Other highlights included Chase Anderson's update on the Montana Heritage Orchard Project and Rachel Leisso's codling moth management for homeowners. Bridgid Jarrett gave a brief introduction to small scale, high-value fruit production including Honeyberries! Our lab is now officially in love with Honeyberries!

We thoroughly enjoyed all the hard work everyone from WARC put into the day but we especially appreciate all the great research they do every day for Montana producers.

McMennamin Receives Award

Alex McMenamin was recently awarded a PhD Fellowship from Project Apis m., a non-profit organization that supports honey bee research.

Alex is currently a PhD student in Montana State University's Pollinator Health Center, which is co-directed by his advisor Dr. Michelle Flenniken. Before coming to MSU he received a B.S. in Immunology and Infectious Disease at Penn State University, where he stayed to complete a M.S. in Entomology under Dr. Christina Grozinger studying the health and behavior of Kenyan honey bees.

His current research focuses on the molecular mechanisms of honey bee antiviral defense to help build a basic understanding of honey bee host-pathogen interactions. This includes projects investigating (1) how the heat-stress response is associated with antiviral immunity, (2) the function of a novel antiviral immune gene and (3) the role of honey bee hemocytes in the antiviral response. The long-term goal is to use that basic understanding to aid the rational development of therapeutics and breeding programs to combat the viral diseases of honey bees.

New Grad Students
Paul Lorenzo (Bruckner)

Originally from Illinois' Chicago suburbs, Paul moved west to Fort Collins, Colorado in 2015 to study horticulture at Colorado State University. While there, he was exposed to a field of study which quickly became his main interest: Plant breeding and genetics. He moved to Bozeman in July of 2019 to continue his studies of plant breeding with a focus on wheat streak mosaic virus resistance in winter wheat. Some of his other interests include hiking, woodworking, playing the guitar, and producing hip-hop beats.

Publications

Blake VC, Woodhouse MR, Lazo GR, Odell SG, Wight CP, Tinker NA, Wang Y, Gu YQ, Birkett CL, Jannink J-L, Matthews DE, Hane DL, Michel SL, Yao E, Sen TZ (2019) GrainGenes: Centralized Small Grain Resources and Digital Platform for Geneticists and Breeders. Database 2019:baz065, https://doi.org/10.1093/database/baz065

Gary Strobel, cover of Microbial Ecology August, 2019.

The Tongass National Forest of SE Alaska is one of the largest temperate rainforests in the world. The humid/moist conditions allows for some remarkable biological events to occur that are absent in drier forests. For instance, it is quite common to find ***nurse trees*** *in temperate rainforests. This phenomenon occurs when a seed lands on a stump or the trunk of a large fallen tree. The seed germinates and the new tree eventually grows and develops in and around its dead host. As per this photo the dead host stump eventually decays revealing the root system of the newly developed tree which is a Western Hemlock. In such cases, it is entirely likely that the endophytic flora of the original dead plant gets readily transferred to the new nurse tree through the root system. Photo courtesy of Gary Strobel.*

Grants

Luther Talbert, "Fusarium head blight resistance for Montana spring wheat", USDA.

Mike Giroux, " New semi-dwarf alleles to improve yield and quality of bread wheat and durum", USDA National Institute of Food and Agriculture.

Mike Ivie, "Pine shoot beetle trapping", Montana Department of Agriculture.

Jamie Sherman, "Barley breeding for Montana: Ensuring a stable malt supply", American Malting Barley Association, Inc.

A Late Growing Season ≠ No Ripe Tomatoes!
By Cheryl Moore-Gough
Extension Horticulture Specialist

Dr. Don Mathre, Professor Emeritus and Gallatin Gardener's Club Farm Manager commented, "Gardening this year has been a real challenge, to say the least".

Seasoned northern gardeners seldom have difficulty plucking fully vine-ripened tomatoes before the first frost, but this year may be different. Observant folks have noticed we are at least two weeks behind "normal" plant development, and the continued pounding rain, wind, hail, and cool nights may set us back even further. We would be wise to use every means in our tomato ripening toolbox to outsmart Mother Nature to assure a bountiful harvest. Here are some tried and true techniques to hasten ripening, as well as a few new ones.

Flowers of full-size tomatoes take about 6 to 8 weeks to develop fully ripened fruit, so calculate back from your first expected frost date (average is September 14 in Bozeman), and at that time, start pulling off any new flowers that form. We know that photosynthates made by the plant are used by the closest and most urgent need. In the case of tomatoes, removing excess flowers that won't yield mature tomatoes anyway allows the plant to concentrate sizing and ripening fruit that has already set. (You can also remove excess flowers any time, once you have enough potentially tomato-forming blossoms to suit you.) In addition, we usually remove

the tops of indeterminate tomatoes after 5 flower clusters have formed, which is typically around August 1, but this year, due to the lateness of our season, we may need to settle for 4 or even 3 clusters. Topping the plants effectively stops vegetative growth and redirects the plants' efforts to ripening fruit that has already set. Watch for new growth and new flowers and remove them.

Don't fertilize your tomato plants after early August and decrease watering. The idea is to slightly stress the plant, which speeds ripening of the fruit.

Tomatoes at "Breaker Stage" develop an abscission layer cutting off any additional sugars.

Recent research tells us that when tomatoes start to show their mature color, called the "breaker stage" they develop a cellular abscission layer between the fruit and the plant, effectively cutting off their supply of sugars. Tomatoes that have reached this stage will have full flavor when finished off the plant. Tomatoes picked when they are still grassy green may change color, but they will not have the same amount of photosynthates of those picked at "breaker stage."
While I've seen no scientific evidence supporting the next ripening technique, I can tell you it has worked in my garden every year for many years. Later in the season, when time is getting short and you still have green tomatoes on the vine, give root pruning a try: With a shovel or spade, partially encircle the plant by slicing the soil about 6 – 12" away from the stem. Don't remove the soil, just cut it. In many instances you will see those green tomatoes start to color within a few days. Again, the idea is to slightly stress the plant.

Root pruning involves slicing, not removing, the soil around the base of the tomato plant.

Finally, if frost is imminent and you still have plenty of unripe tomatoes, you can cover them to hold in the heat of the earth and hope for one of our gorgeous warm autumns, or bring the tomatoes inside, either on or off the vine. There are many ways to be successful at this, and I've probably tried them all: Hanging the vines upside down while the fruit turn color, spreading the tomatoes on newspapers after removing them from the plant, and even the tedious wrapping of individual tomatoes in newspaper. They all seem to work, but tomatoes picked at the breaker stage or later have the most sugars, and therefore, flavor!

Recipe of the Month

Grilled Corn Salad with Hot Honey–Lime Dressing

Wash 3 ears of corn, husked
2 Tbsp. unsalted butter, melted
1½ tsp. kosher salt plus more to taste
Freshly ground black pepper
3 Tbsp. fresh lime juice
2 Tbsp. honey
1½ tsp. Sriracha
1 tsp. granulated garlic or garlic powder
1½ avocados, cut into ¾" pieces
1 serrano chile, thinly sliced
½ cup cilantro leaves with tender stems

Prepare a grill for medium-high heat. Brush ears of corn with butter; season with salt and pepper. Grill, turning occasionally, until

kernels are very tender and charred in spots, 10– 12 minutes. Let cool slightly, then cut kernels from cobs.

Meanwhile, whisk lime juice, honey, Sriracha, granulated garlic, and 1½ tsp. salt in a large bowl to combine. Add corn, avocados, chile, and cilantro to vinaigrette and toss to combine; season with salt and pepper. Cover with plastic wrap, pressing in direct contact with salad to prevent avocados from turning brown. Chill at least 2 hours.
Salad can be made one day ahead. Keep chilled.

August Birthdays

Charles Watt	3
Nancy Cooke	12
Swarna Moparthi	14
Mike Ivie	16
Raman Sandhi	21
Karen Maroney	23
Bright Agintodan	25
Ruth O'Neill	26
David Sands	30

Go to next page for photos of the Arthur H. Post Farm Field Day.

10 Mike Giroux, PSPP Dept. Head, welcomed everyone to the field day before the tours started.

Jeff Todd, Post Farm Foreman, Dave Gettel, Post Farm Operations Manager, and Doug Holen, Foundation Seed Manager – the employees that are essential to the success of all the research that happens at the Post Farms!

David Gettel, Post Farm Operations Manager and President Waded Cruzado

Sreekala Bajwa, Dean of the College of Agriculture and Bruce Maxell, LRES Professor.

Luther Talbert, PSPP Professor speaking on Yield Components in Wheat and selecting for increased wheat yield in rapidly changing environments.

Phil Bruckner, PSPP winter wheat breeder and Jack Riesselman, PSPP Professor Emeritus.

Jamie Sherman, PSPP Asst Professor and Doug Holen, MSU Foundation Seed Program Manager.

Jessica Torrion, Asst Professor, NWARC, speaking on how to apply irrigation to maximize crop yield.

Soil scientist Jerry Nielsen and Huang Li, Postdoctoral Scientist.

McKenna Brown, Maddison Milliman, Robin Happel, Rachel Johnston, and Allison Capron made sure everyone had a wonderful lunch!

MSU

Post Farm

Field Day

July 23, 2019

Kevin Mcphee, PSPP Professor speaking with MSU student Isabelle Wieseler and Kevin Peterson, Director of Development for the Alumni Foundation. In the background, you can see the Foundation seed stocks of MSU wheat and barley varieties that line the wall of the storage building where the lunch was held.

Ed Davis, LRES Cropland Weed Researcher, described new weed management solutions and emerging problems.

Tracy, Hoogland, PSPP Grad student, speaking on the types of cameras used on her drones to measure plant growth remotely.

Mike Giroux, PSPP Dept. Head and MSU President Waded Cruzado.

6 Megan Brewer Jones, PSPP Grad student speaking on how to measure the impact of individual genes upon wheat yield components.

Kristi D'Agati, LRES grad student, talked about long term soil changes by planting different cover crops.

Perry Miller, LRES Professor, speaking on cropping systems strategies.

Syd Atencio, LRES grad student, talked about lentil management and controlling fusarium root rot.

Seed storage tanks.

One of MSU's fertilizer spreaders which can be set for inter-row banding or broadcast fertilization.

Plot seeder.

Winter-Steiger plot combine.

Foundation seed stocks of MSU wheat and barley varieties.

Tim Siepel, LRES Cropland Weed Researcher, described how to control common weeds and common herbicide injury symptoms.

Joseph Jensen, PSPP Grad student, Jamie Sherman PSPP Asst. Professor, Hannah Turner, Barley Malt Quality Lab Manager, and short term worker Greg Lutgen.