PSPP - Plant Science Says *February 2018*

Fall 2017 Graduates

Congratulations to the following graduates!

Undergraduates

Landscape Design:

Barker, Erin
Donald, Samuel
Neutgens, Hailey
McDowell, Dylan

Environmental Horticulture Science:

Willey, Samantha

Crop Science:

Bronec, Samuel
Guenthner, Christian
Hoferer, Tyrel
Jackson, Erik
Spicher, Cooper
Tracy, Jacob
Webster, Richard

Sustainable Crop Production:

Sternke, Molly
Westphal, Iesha

Graduate Students:

Ozseyhan, Mehmet; MS in Plant Science - Plant Genetics
Kaya, Eylul; MS in Plant Science - Plant Pathology

Cripps Wins Anna K. Fridley Award

Cathy Cripps, professor in MSU's Department of Plant Sciences and Plant Pathology, and Gretchen Minton, professor in MSU's Department of English, have won the Phi Kappa Phi Anna K. Fridley Award, MSU's oldest award for distinguished teaching. Each will receive a $1,000 honorarium.

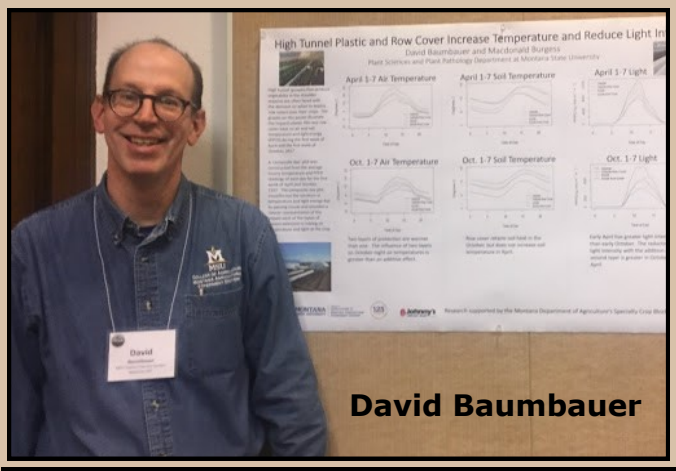
For the past 22 years, Cripps has been an integral part of the Plant Sciences and Plant Pathology department. Her colleagues consider her a well-regarded, caring and knowledgeable researcher and a dedicated instructor whose engaging personality, enthusiasm, endless energy and experience produce impressive academic gains for students studying mycology. As an educator, Cripps is known for her hands-on teaching method that helps students understand complicated and diverse sets of organisms. In the lab, she shares her research techniques with her students and helps them hone their scientific writing skills. Because of her influence, support and oversight, Cripps' students have obtained competitive grants and scholarships. Colleagues say her influence endures long after students leave her classroom.

Day Awarded Member of the Year
The Montana Nursery & Landscape Association is a trade association of approximately 225 members from the United States and Canada. Its members are primarily in the green industry and include businesses such as garden centers, plant nurseries, landscape companies, landscape maintenance, arborists, and underground irrigation companies. Its goal is to provide education, information, and opportunities for professional development to its members.

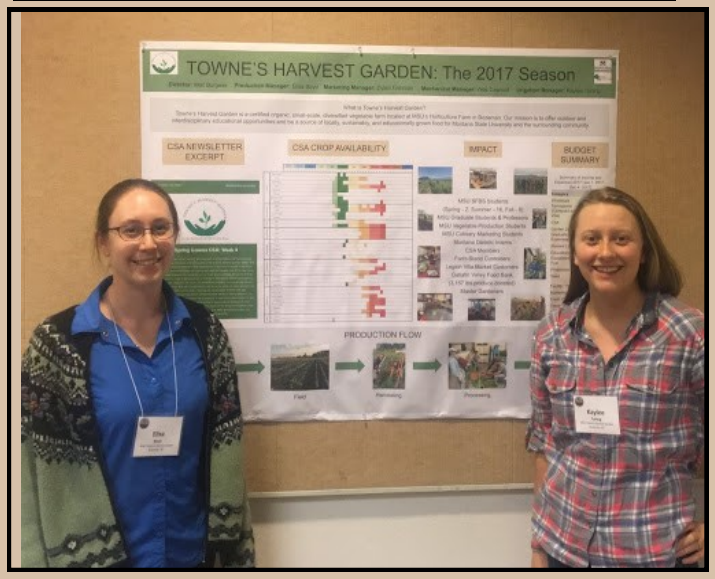
The MNLA Member of the Year Award, an award that was created to honor and recognize excellence in the nursery and landscape industry, is presented annually to an individual member or member company at the Montana Green Expo annual banquet. The banquet was held this year in Missoula on January 10th at the Hilton Garden Inn and this year's recipient was Toby Day. Toby is the Extension Horticulturalist at Montana State University in Bozeman. He has been a great supporter of MNLA and is always available to offer assistance whether it be speaking at the Montana Green Expo, offering a presentation to a Chapter meeting, grant writing assistance, or offering a wealth of plant knowledge. Toby has been a great supporter of MNLA and stated this was his 22nd year of attending the Montana Green Expo. Congratulations Toby! MNLA values their partnership with Montana State University Extension and the great work you do.

Toby Day receiving the Member of the Year Award

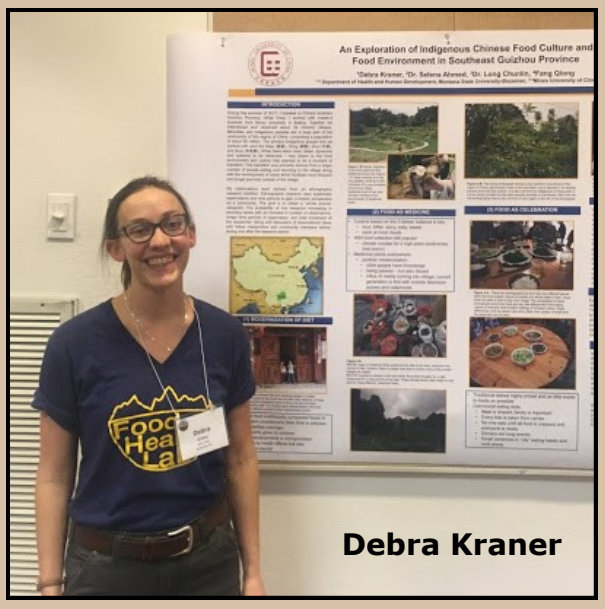
Organic Association Meeting
By Mac Burgess
On December 8, Mac Burgess, David Baumbauer, Elisa Boyd, and several students attended the Montana Organic Association Meeting in Great Falls, Montana. David presented a poster showing highlights of his research on season extension for cool season vegetable production. Elisa Boyd and SFBS student Kaylee Tuning presented an update on Towne's Harvest Garden's 2017 season. SFBS student Debra Kraner presented on her summer internship in rural China, and SFBS student Kaitlyn Albers presented on her summer internship in Minnesota.



David Baumbauer



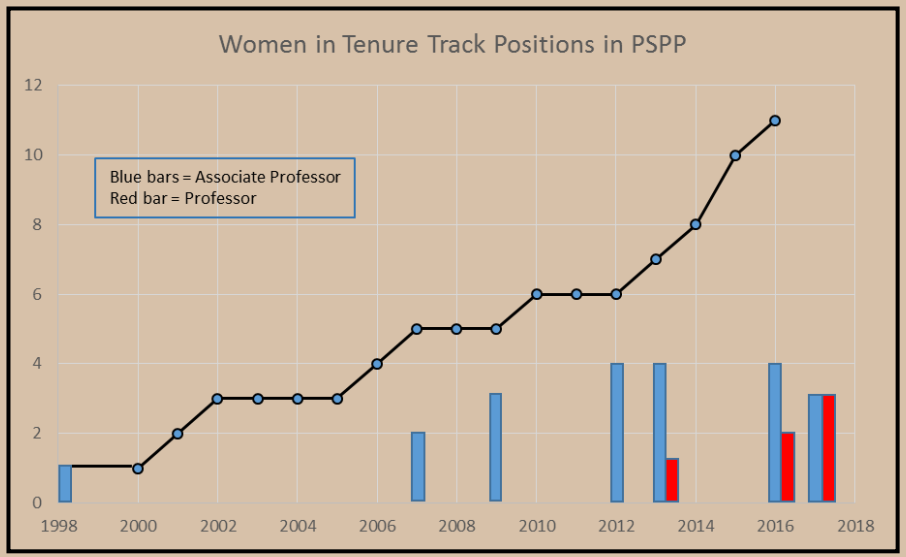
Elisa Boyd and SFBS student Kaylee Arnold



Lunch at The Brewery—Drs. Cathy Cripps, Mary Burrows, Tracy Dougher, Jamie Sherman, Rebekah VanWieren, Michelle Flenniken, Jennifer Lachowiec, and Nina Zidack.

Number of Women Faculty Increases
By Cathy Cripps

In 2017, ADVANCE, an NSF-funded project designed to improve gender equity at MSU, published the Impacts Highlight Report. The report emphasized a 9% increase in women in tenure track positions at MSU from 2009-2017, the duration of ADVANCE. Overall, tenurable faculty at MSU is now comprised of 41% women, and 28.9% women in STEM fields. Table 2 in the report lists the number of women in three colleges as: 45 for the College of Letters and Science, 35 for the College of Agriculture, and 20 for the College of Engineering. On a departmental level for these three colleges, Plant Sciences and Plant Pathology led with 10 women in tenurable faculty positions (now 11), followed by Mathematical Sciences (9), and Agricultural Economics & Economics (7); there are 3-6 women in each of the 17 other departments listed.



Within the department, PSPP moved from one woman in a tenure track position prior to 2000 to 11 in 2017, and women now make up 37% of the faculty. The number of female Associate Professors started to increase in 2007 and the first female was elevated to Full Professor three years ago in 2013; there are now three women at each advanced level. All but two of the female faculty were hired under the leadership of John Sherwood as Department Head.

Grants to women faculty have conservatively totaled over $3 million in the last few years. In addition, the MSU Potato Lab, the Montana State Seed Testing Lab, the Schutter Plant Diagnostic Lab, the Montana Seed Grower's Association, and the Cereal Quality Lab have female leadership, and there is a strong cadre of female research professors and technicians in the PSPP department; women make-up 67% of PSPP professional faculty and staff.

PAG 2018
By Emma Jobson

The Plant and Animal Genome (PAG) Conference was held January 13-17 in sunny San Diego. Dr. Mike Giroux, Dr. Hikmet Budak, Dr. Luther Talbert, Dr. Jason Cook, Brittney Brewer, Emma Jobson, and Justin Vetch attended this year. The conference brought over 3000 attendees from all over the world with diverse academic backgrounds. The workshops covered everything from crop genetics and genomic assisted breeding to rhinoceros genetics and the genetics of ancient species.

Many of the keynote speakers focused on the challenge of producing more food with even fewer natural resources than in the past. We learned about high throughput phenotyping devices that can plug directly into plants and soil, as well as approaches to streamline targeting genes of interest. Other talks focused on the role of rapidly developing computer technology and the need for even greater interdisciplinary collaboration between biologists, computer scientists, and engineers. A group from Australia presented their recent work done on "speed breeding"; an intensive greenhouse technique which has shown to yield up to six generations of wheat in a single year.

Emma Jobson, Brittney Brewer, and Justin Vetch at Balboa Park after the poster session.

On Monday, Brittney Brewer, Emma Jobson, and Justin Vetch presented posters focused on introgressing durum wheat yield QTLs into spring wheat, developing novel dwarfing genes in wheat, and identifying the genes associated with pre-harvest sprout in wheat and barley. In total there were over 1200 posters at the meeting. It was a great opportunity to meet with researchers from all over the world and get valuable feedback and ideas.

Graduates Riyadh and Mehmet
Mehmet Ozseyhan

I recently received my Master's in Plant Science with Chaoful Lu as my advisor. I have applied to the University of Nebraska for a Ph.D. and hope to hear from them soon. Thank you to my committee members Chaofu Lu, Mike Giroux, and Bob Sharrock for their help in completing my degree.

Riyadh Al-Khafaji

I recently received my Ph.D. in Plant Sciences with Dr. Alan Dyer as my advisor. My journey to a Ph.D. began on June 8, 2011, when I arrived in Bozeman with my wife and four children, all under the age of 8. The weather in Bozeman took some getting used to because it is very different from the hot, dry

Back Row: Dr. Alan Dyer, Samaa Al-Khafaji, Dr. Riyadh Al-Khafaji, Ghusoon Al-Badri, and Ahmed Al-Khafaji
Front row: Talib Al-Khafaji, Noor Al-Khafaji and Tiba Al-Khafaji

weather in Bagdad. My first year, I studied English with the ACE Institute here on campus and then on August 27, 2012, I started my PhD program in Alan Dyer's lab. Being a PhD student with a large family was difficult because there were always things that needed to be done in school and at home. However, there were opportunities that we took advantage of such as driving to Los Angeles, San Diego and Salt Lake City. A broken tibia was the result of my attempt at skiing but I did learn how to swim/dive. I saw the magnificent redwood trees in northern California and the giant cactus in Tucson, Arizona. My family and I will be leaving for Iraq soon so now we are focused on renewing our passports, packing...etc.

Thank you to Alan Dyer for giving me the opportunity to study here and for all his help and support. Also, thank you to my lab mates, Jeff Johnston and Erin Troth for all their assistance.

Finally, I would like to thank everyone at Montana State University and the PSPP Department for all I have learned during my time here and for the chance to explore the Western United States.

New Employees
Elisa Boyd

Elisa Boyd is now the Production Manager for Towne's Harvest Garden. Towne's Harvest is a three-acre organic vegetable farm located at the Bozeman Area Research and Teaching Farm. The farm employs students and hosts the SFBS practicum course every summer. Food grown is distributed through community supported agriculture (CSA) shares and two farm stands. Excess produce goes to the Gallatin Valley Food Bank (over 4,000 lbs last summer).

Elisa was the interim production manager last summer and is excited to continue on in this permanent position. She completed her Bachelor of Science in Environmental Horticulture and Masters in Plant Pathology at Montana State University. In her free time, she enjoys the outdoors while hiking and skiing. She looks forward to working outside with students and furthering sustainable agriculture education while supplying the community of Bozeman with fresh organic produce.

New Graduate Students
Jake Tracy (Kevin McPhee)

My name is Jake Tracy and I am a new graduate student pursuing a Master's degree in Plant Science. I received my Bachelor's degree in Crop Science from Montana State University this past fall. I will be working with Dr. McPhee's Pulse breeding program, addressing salt stress in field peas,

lentils, and chickpeas grown throughout this beautiful state.

I grew up in the dairy country of Vermont and have an agricultural background in small-scale organic vegetables and berries. I came to Montana for a different agricultural perspective and fell in love with the fields of crops extending to the horizon and the tremendous relationship between MSU extension and Montana's agricultural community.

I decided to pursue higher education in plant improvement after working and conducting my undergraduate research in Dr. Bruckner's Winter Wheat breeding program last season. The immense cumulative knowledge between the veteran faculty of the program helped shape my deep appreciation for, and fascination with, every aspect of a plant improvement pipeline.

I'm excited to join the momentum of Montana's pulse crop industry and look forward to addressing the needs of the increasing number of producers now reaping the many benefits of adding pulses into their crop rotations. When I'm not working, I can be found up in the mountains hiking and boarding or down in the valley kicking a ball around and volunteering at the Eagles.

Fenali Parekh (Michelle Flenniken)

I am a new PhD student in Michelle Flenniken's lab, joining the lab in Spring 2018. I am fascinated by how the buzzing bees tackle the problem of viral infections. I am interested in exploring the mechanisms of dsRNA-triggered honey bee antiviral defense by performing both *in vivo* (in bees) and *in vitro* (in cultured cells) experiments and examine the metabolic profile of virus-infected bees. I earned my B.S. and M.S. degree in Biotechnology from Pune University, India, after which I worked with the government of India in the profile of a Patent Analyst.

I had never experienced snow until I first landed at the Bozeman Airport. But watching the snow fall is beautiful and looking at snow settled outside looks even more beautiful. I am looking forward to hiking in the summer in and around Bozeman. I love to travel and enjoy spending my free time outdoors.

Eleanor Brant (Hikmet Budak)

Hi! My name is Eleanor and I moved to MSU just after Christmas to start a PhD in Plant Genetics in Dr. Hikmet Budak's lab. I'm originally from a town in the United Kingdom called Wednesbury (near Birmingham!). In terms of academia, I completed a BSc in Plant Biology at Aberystwyth University, which is in a very pretty seaside town in Wales, then went on to complete an MRes using CRISPR/Cas9 to investigate disease resistance in Arabidopsis at the University of Worcester. My project here is mainly focused on utilizing gene editing techniques for miRNA silencing in wheat. I am looking forward to seeing where my PhD takes me!

My hobbies include hiking, rock climbing, and taking photos of plants. I love to travel and experience different cultures and am excited at the prospect of seeing more of the U.S. while I complete my studies.

Gilllian Reynolds (Hikmet Budak)

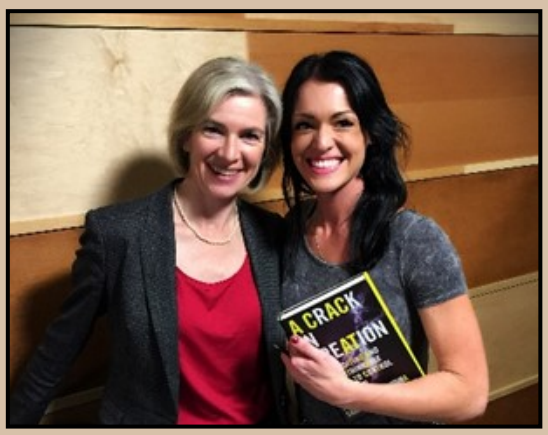
My name is Gillian Reynolds and I'm a new student from Worcester, England and I am currently studying as a PhD student in Professor Hikmet Budak's lab. I graduated in 2014 with my Bsc Biology (Hons) from the University of Worcester, and this is where I also studied for my MRes in Biology. Since my undergraduate degree, I

Gillian Reynolds

have had an avid interest in the application of computer science to answer biological questions and I have previously worked with phylogenetics, RNA-Seq and bacterial whole genome assembly and annotation. I am currently working on whole genome and exome data from wheat, which is significantly more challenging than my previous projects thanks to its complex genome. I am also looking to branch out into machine learning and its applications in the identification of microRNA's so I have a lot of learning to do! In my free time I enjoy being outdoors hiking or practicing my photography or, if I'm indoors, I love baking and crocheting. I try not to spend much of my free time in front of a computer!

Plant Sciences Graduate Student Meets Inventor of CRISPR
By Whitney Harchenko

Plant Sciences graduate student Whitney Harchenko recently attended a public forum held at Montana State University entitled, "Technology, Humanity and Nature: Possible Futures." There she had the opportunity to meet and talk with acclaimed scientist, Dr. Jennifer Doudna. Doudna is best known for her discovery of the CRISPR/Cas9 targeted genome editing technology. Harchenko discussed with Doudna her own research project using Doudna's technology with hopes to develop resistance to *Potato Virus Y* in potato. Doudna's response was, "Potato? I haven't heard of that one!" Harchenko plans to send Doudna her CRISPR research paper when it is compete.



Dr. Jennifer Doudna and Whitney Harchenko

Harchenko described Doudna as a very personable and down to earth lady; however, she is still star struck and will never forget meeting one of the greatest scientists of her time.

Publications

Note: According to Oxford University Press data, the following publication is currently the most cited article in the American Entomologist since 2012.

Anton Alexander, Florence V Dunkel; Local Malaria Elimination: A Historical Perspective from Palestine 100 Years Ago Informs the Current Way Forward in Sub-Saharan Africa, *American Entomologist*, Volume 63, Issue 4, 12 December 2017, Pages E1–E14, https://doi.org/10.1093/ae/tmx060

Note: This article has been recommended in F1000Prime as being of special significance in its field.

Mehmet E. Ozseyhan, Jinling Kang, Xiaopeng Mu, and Chaofu Lu. (2018). Mutagenesis of the *FAE1* genes significantly changes fatty acid composition in seeds of *Camelina sativa*. Plant Physiology and Biochemistry 123, 1-7.

Ranabhat, N.B., Seipel, T., Lehnhoff, E.A., Miller, Z.J., Menalled, F.D., and Burrows, M.E. 2017. Temperature and alternative hosts influence *Aceria tosichella* infestation and *Wheat streak mosaic virus* infection. Plant disease. DOI 10.1094/PDIS-06-17-0782-RE.

Sogutmaz Ozdemir B., Budak H. (2018) Application of Tissue Culture and Transformation Techniques in Model Species *Brachypodium distachyon*. In: Sablok G., Budak H., Ralph P. (eds) Brachypodium Genomics. Methods in Molecular Biology, vol 1667. Humana Press, New York, NY.

Halise B. Cagirici, Sezgi Biyiklioglu, Hikmet Budak, Assembly and Annotation of Transcriptome Provided Evidence of miRNA Mobility between Wheat and Wheat Stem Sawfly Frontiers in Plant Science Front. Plant Sci., 26 September 2017 | https:// doi.org/10.3389/fpls.2017.01653.

Xie, J., Shu, P., Strobel, G., Chen, J., Wei, J., Xiang, Z., and Zhou, Z. (2017) *Pantoea agglomerans* SWg2 colonizes mulberry tissues, promotes disease protection and seedling growth. Biological Control 113: 9-17.

Gary Strobel, Cover photo of Microbial Ecology The Western Atlantic Railroad built this tunnel at Tunnel Hill Georgia just prior to the Civil War. At the time it was the longest railroad tunnel south of the Mason Dixon line at 1477 feet. It was through this tunnel that the Locomotive (the General) ran after having been stolen by union leader Jim Andrews and his band of hijackers in the spring of 1862. The Western Atlantic carried the slain body of the famous confederate artillerist - "the Gallant Pelham" to be buried near his home in NE Alabama in 1863. The line also served as a supply route for General Sherman in his march on Atlanta in 1864. Today, with all of the historical highlights of this place in the past, the microbes, quite literally, have taken over. The tunnel has gained beautiful colorful hues by virtue of huge populations of algae, fungi and bacterial species that cover its dampened walls.
Photo courtesy of Gary and Suzan Strobel

Grants

Montana Wheat and Barley Grants

Deanna Nash, "Improved Quality of Montana Hard Red and Hard White Wheat".

Jamie Sherman, "MSU Barley Quality Laboratory: Empowering Barley Quality Improvement through Screening and Genetic Dissection".

Andreas Fischer, "Drought and grain protein concentration: Two related problems impacting Montana malting barley production".

Jason Cook, "Molecular Breeding Pipeline for Wheat".

Luther Talbert, "Spring wheat breeding and genetics".

Jack Riesselman, "Montana Ag Live".

Hikmet Budak, "Genome sequencing, assembly and annotation of a leading Montana cultivar, Yellowstone."

Hikmet Budak, "Building Genomics Foundations to Accelerate Montana Wheat/ Barley Improvement".

Alan Dyer, "Advance Disease Resistance in Montana's Wheat".

Mary Burrows, "Wheat Streak Mosaic Virus Variety Trials".
Mike Giroux, "Durum Varietal Improvement and Quality Testing".

Mike Giroux, "Assessment and Management of Preharvest Sprout and Falling Number in Montana Small Grains".

Other Grants

Jamie Sherman, Brewers Association, "Stable and sustainable dryland production of high quality malt barley".

Jessica Rupp, MT Dept of Ag, "Potato virus Y (PVY) phenotyping studies and continued precision genome editing in potato".

Nina Zidack, MT Dept of Ag, "Evaluating resistance inducers as management tools for PVY and transferring laboratory supervision expertise in the Potato Lab".

Cathy Cripps, Daniel E. Stuntz Memorial Foundation, "Alpine Cortinarius section Anomali from the Western United States".

Invited Talks

Hikmet Budak, Comparative Omics Analysis of Stem solidness in wheat and its synteny with closely related species. Plant and Animal Genome meeting, San Diego, CA, USA. 2018.

Hikmet Budak, Annotation of Noncoding RNAs in Wheat Stem Sawfly and Wheat. Plant and Animal Genome meeting, San Diego, CA, USA. 2018.

Free Tax Assistance
By Don Mathre

Get your income tax returns (both Federal and Montana) prepared and filed electronically for free. Don Mathre is once again participating in the IRS sponsored program called Tax-Aide. He has being doing this for 11 years and is certified by the IRS to prepare income tax returns. Returns are done by appointment only at the Bozeman Public Library on Tuesdays beginning in February from 11 am until 6 pm. Contact Don at 587-8666 or mathre@q.com if you would like to make an appointment or if you have income tax related questions. He's also here in the dept MWF from 10 am until 11 am in room 315.

It's Time to Prune Those Trees!
By Toby Day, Horticulture Extension Specialist

Every February, I load up pruners, saws, chainsaws, ladders, disinfectant, safety equipment and volunteer Master Gardeners and travel to Heritage orchards throughout Montana to prune Heritage apple trees. Through our grant we prune trees that, oftentimes, haven't been pruned for decades. And they are a mess.

The Master Gardeners that help have varying practice and education on proper pruning. After unloading the truck and a quick overview of our project, we give a hands-on class on proper pruning. Then we pair up volunteers that have had pruning experience with those that don't, and we go to work. 100-year-old apple trees that haven't been pruned for 40 years provide all the opportunity needed to learn the art of the three-cut method (see photo), why we leave the branch collar, where and how to make a pruning cut, why it is important to sanitize your pruners, and how to be safe doing it! Before we send them out to prune, I give them a 15-minute talk about the 7-step method for pruning. No, pruning is not an addiction, although I have many volunteers that volunteer regularly so that they can get their pruning fix.

The 7- step pruning method:

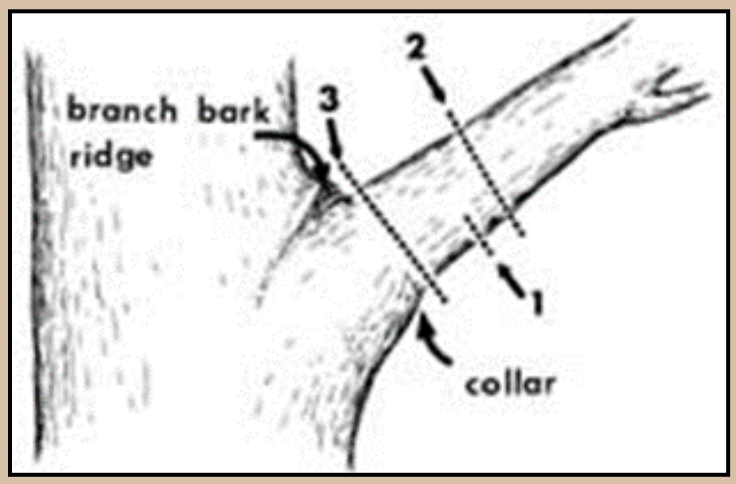
- Remove all dead and broken branches. If you are uncertain if a branch is dead, scrape the bark with your fingernail. If the cambium (under the bark) is green, it is likely still alive. If it is brown, the branch is dead.
- Clean up stubs. For example, a stub might have been left from previous pruning where it was pruned incorrectly.
- Remove all suckers and water sprouts. Suckers are what appear at the base of the trunk, whereas water sprouts are fast growing growth that grows from larger branches. In either case, they are weakly attached and rob water and nutrients for the rest of the tree.
- Remove rubbing or crossing branches. Pick the one you think should be removed.
- Remove any narrow or weak crotch angles. A proper branch angle is 45°

to 90°. If the angle is narrow and you see included bark, remove the branch.

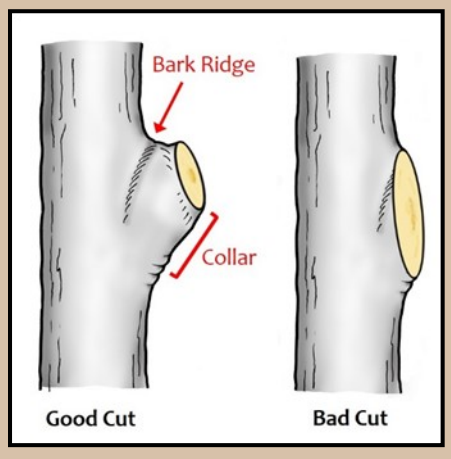
Prune to a single leader. You want one dominant top branch in most cases for ornamental trees. Fruit trees are different, whereas you may not want a central leader.

Remove parallel branches. Parallel branches will grow in diameter. When they eventually meet, one branch can often cause another to break. Prune out the one you feel needs to go.

Using these 7 steps, you will able to prune most of your trees well. You may run into situations where you don't know what to do, or you may have large trees or trees with power lines running through them. If you are unsure and feel unsafe pruning your tree, hire a professional arborist. Just be sure that they are ISA (International Society of Arboriculture) certified.



The Three-Cut Method for larger branches keeps the branches from peeling bark as they fall.



Always leave the branch collar when pruning. It will heal faster. http://blog-yard-garden-news.extension.umn.edu

Included bark due to a narrow branch angle. Included bark creates a weak attachment and can fail. https://www.extension.umn.edu/environment/trees-woodlands/storm-damage-to-landscape-trees/

Recipe of the Month
Stir Fry Sauce

This sauce is good with any kind of meat or no meat at all and just vegetables!
1/2 cup low sodium soy sauce (or Tamari if gluten free)
1/2 cup chicken broth
1 tablespoon corn starch
1 tablespoon honey
1 teaspoon sesame seed oil
1 teaspoon rice vinegar
2 inch piece of ginger, peeled and grated or finely minced or 1 tablespoon ginger paste in a squeeze tube or 1 tablespoon ground powdered ginger.
2 garlic cloves, grated or finely minced.

Whisk all ingredients together. Adjust the amount of sauce you add according to how much stir fry you're making. When adding to your stir fry, allow to cook for 3 full minutes to allow the corn starch to thicken the sauce. Whisk all ingredients together. Adjust the amount of sauce you add according to how much stir fry you're making. When adding to your stir fry, allow to cook for 3 full minutes to allow the corn starch to thicken the sauce. Makes 1-1/4

cups. Will keep refrigerated in an airtight container for 1 week.

February Birthdays

Jeffrey Johnston	2
Carmen Pol	14
Alan Dyer	15
Phil Bruckner	17
Niranjan Aryal	22
Hwa Young Heo	24