

Appendix 1: Group Photo



Attendees of the 2019 WERA-103 meeting in Reno, NV. Photo by Ken Greer.

Appendix 2

WERA-103 Annual Meeting, March 6, 2019, Reno, Nevada

Minutes Submitted by Jay Norton, March 11, 2019

Participants

1. Blaylock, Alan Nutrien, Denver, Colorado
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4. Davenport, Joan R. jdavenp@wsu.edu Washington State University
5. Deenik, Jonathan jdeenik@hawaii.edu University of Hawaii
6. Dellavalle, Nat B. n.dellavalle@dellavallelab.com Dellavalle Laboratory, Inc
7. Ellsworth, Jason Wilber-Ellis, Inc.
8. Fernandez, Fabian G fabiangf@umn.edu University of Minnesota
9. Flynn, Robert P rflynn@nmsu.edu New Mexico State University
10. Geisseler, Daniel djgeisseler@ucdavis.edu University of California, Davis

11. Greer, Ken kengreer@westernag.ca Western Ag Innovations Inc.
12. Hopkins, Bryan hopkins@byu.edu Brigham Young University
13. Ippolito, James Jim.Ippolito@ColoState.EDU Colorado State University
14. Jones, Clain clainj@montana.edu Montana State University
15. Koenig, Richard richk@wsu.edu WERA-103 Administrative Advisor Washington State University
16. Mikkelson, Rob International Plant Nutrition Institute, Atlanta, Georgia
17. Miller, Robert rmiller@lamar.colostate.edu Manure, Compost and USGAPT Proficiency Programs
18. Moore, Amber D. amber.moore@oregonstate.edu Oregon State University
19. Mooso, Galen galen.mooso@simplot.com J.R. Simplot CO
20. Nelson, Dan dan@soiltestlab.com Soiltest Farm Consultants, Inc
21. Norton, Urszula unorton@uwyo.edu University of Wyoming
22. Norton, Jay B. jnorton4@uwyo.edu University of Wyoming
23. Rogers, Christopher W cwrogers@uidaho.edu University of Idaho
24. Smith, Cindy International Plant Nutrition Institute
25. Sullivan, Dan dan.sullivan@oregonstate.edu Oregon State University
26. Tao, Haiying haiying.tao@wsu.edu Washington State University
27. Tarkalson, David david.tarkalson@ars.usda.gov USDA-ARS/Idaho
28. Walworth, Jim walworth@ag.arizona.edu University of Arizona

Vice-chair Eric Bremer opened the meeting at 8:30 am, explaining that chair Olga Walsh, University of Idaho, was not able to attend.

Update on IPNI closure (Rob Mikkelson)

IPNI will close at the end of May, 2019. Rob M. is not able to offer an explanation for the upper management decision to stop funding IPNI, but he and Alan Blaylock described some philosophical differences among member organizations, particularly on whether educational emphasis should be on agronomy or on sustainability. All agreed with a statement by Bryan that this represents the loss of an impactful and unbiased organization. Rob described the future of some IPNI functions:

1. The 4R fund: the Foundation for Agronomic Research will manage and activities will continue;
2. IPNI Website will be supported by Fertilizer Canada through the end of 2019. Anything on the Website can be downloaded and used for non-commercial purposes;
3. Archived proceedings from conferences supported by IPNI, including WMNC: these have all been transferred to flash drives and will need a permanent home (discussed later by the group).

Executive committee election

David Tarkalson volunteered to become the incoming secretary as of the end of this meeting and was quickly voted in. For 2019, Chair is Eric Bremer, Vice-Chair is Jay Norton, Secretary is David Tarkalson.

Discussion of the future of the WMNC without IPNI support (this discussion continued through the week and those developments are included)

IPNI is a non-profit organization supported by the fertilizer industry that has provided logistical support for the WMNC for many years, and also for the Great Plains Soil Fertility Conference and the North Central Extension-Industry Soil Fertility Conference. Primary components of the support include handling registration (including on-site registration, name tags, etc.); working with the WERA-103

conference committee to coordinate the venue, food, and lodging; formatting, publishing, and archiving the proceedings; managing the conference/WERA-103 Website; and, very importantly, managing the bank account for conference income and expenses, as well as for annual WERA-103 meeting expenses. Cindy Smith provided an estimate of in-kind services provided by IPNI of about \$20,000 per conference.

[Note: in the 2018 minutes, Rob asked the group if they could provide more support to offset the need for an on-site IPNI employee at the registration desk and other aspects. The group agreed, but this was not addressed in conference planning because of the turmoil surrounding the sudden dissolution of IPNI. The group should perhaps consider hiring help to manage on-site registration in the future.]

Several possibilities for future WMNC management, and the conditions for partnering with other organizations, were discussed;

1. If possible, WERA-103 should partner with the GPSFC and NMEISFC groups to explore the possibility of increasing buying power;
2. The group agreed that we need a partner for administrative support but that WERA-103 must retain control over WMNC planning, content, speakers, etc.;
3. The Fertilizer Institute, which is the group that also served as the IPNI board of directors, may offer to support the conferences. There are concerns among the group that TFI may want a narrower scope for the conference, but agreement that we need to see what they offer;
4. Conference services of the ASA-CSA-SSSA Tri-Societies (or SSSA). The main concerns for this option are cost and a fear by some that they would exert control over content, but it will be explored;
5. Hire an individual or conference management firm (such as Phyllis Pate). The main concern here is that the WMNC planning group is not an organization capable of having a bank account, and there was unanimous agreement that we do not want to become such a group (i.e., a non-profit organization), so we need to partner with an organization that could do that. Also, it was pointed out that Phyllis would not have the resources that were available through IPNI;
6. University conference planning services: There were many concerns about this, such as cost, state specificity, ownership, etc.;
7. Partner with conference management services offered by the venue, such as the El Dorado Hotel: This will be explored, including their ability to manage funds;
8. Establish the Western Nutrient Management Society as a chapter of SSSA with the primary function being the biennial conference, similar to the California Plant & Soil Conference, which is organized by the Cal chapter of ASA. There were concerns raised about control, but this will be explored;
9. The Far West Agribusiness Association: this group provides CCA training and sponsors two conferences that are similar to the WMNC. Jay discussed the possibility with Executive Director James Fitzgerald at the WMNC. He is very interested and would like to see the scope of work involved in order to discuss costs. He would not support organizing the other regional conferences, but suggested that they could work with their regional agribusiness associations;

A subcommittee was formed, including the executive committee, Cindy, Jim I., Joan, Alan, Grant, and Fabian serving as a resource/SSSA liaison.

It was discussed and decided that the committee would meet following the WERA-103 meeting to define their tasks, and that they would communicate with the rest of the group on a regular basis.

Minutes from the brief meeting include that we agreed on a Zoom video conference on April 26 at 2:00 PM Mountain Time. Jay will set up the meeting and send out the link. Objectives prior to that are to develop the scope of work for any entity we partner with, including a “stripped down” version of the conference to cut costs, and also for members to explore options that they are aware of. TFI is meeting soon to discuss their position on helping with the conference, and we will proceed with that information. Other charges include finding a temporary account situation if a new partnership is not developed before the end of May and finding a new site for archiving the proceedings (both discussed below).

Financial Update

Balance is about \$20,000. Over each two-year cycle the conference brings in about \$20K and we spend about \$20K for the next conference (not including another \$20K in kind from IPNI). Goal is to retain that balance to cover costs in case of conference failure, such as because of bad weather or other reasons. Discussion turned to options for moving this balance out of IPNI account by the end of May, 2019. Rich K. suggested that we do not move the account to a university. Modern university accounting makes it very slow and difficult to spend funds. All agreed.

The idea of temporarily opening a private checking account was discussed but it was realized that WERA-103 has no organizational ability to possess and spend funds. This makes it more important to partner with an organization like TFI, SSSA, or Far West Agribusiness soon. If such a new partnership does not materialize in time, we will look to temporarily house the account with one of those or another organization.

Future of the WNMC Proceedings and Recordings

Eric has all the proceedings in digital form on flash drives. They are still on the IPNI Web site, but that will be taken down at the end of June. Ideally they will be stored in a permanently accessible location so they can be read and cited. It was pointed out that they had previously been housed at Oregon State University and then transferred to IPNI. Options for a more permanent repository to be considered by the subcommittee include:

1. A university library digital repository;
2. Other university-sponsored Web site, such as the site managed at WSU by Haiying Tao;
3. Private Web site utilizing Google, Wix, Wordpress, or a similar service;
4. SSSA or similar organization;
5. A commercial archiving service that specializes on conference proceedings.

Additionally, recordings created during 2019 by WERA-103 members and possible future recordings of WNMC presentations could be housed in the same place. David T. volunteered to explore recording and digitally storing conference presentations (talks and posters) as is done by the Tri Societies. It was suggested that this could replace the need for annual proceedings because it would be accessible and citable, and would reduce costs and workload for conference planning.

Contributions to Crops & Soils (Tri Societies publication for CCAs)

These are short (~800 word) articles followed by quiz questions for purposes of training and CEUs for CCAs. They are due on the first of the month, and volunteers/subjects for 2019 are as follows:

May 1: Nat, Gypsum requirements;
June 1: Grant, N requirements following alfalfa;
August 1: Christopher, CaCO₃ testing;
October 1: Joan, blueberries;
December 1: Jim W., soil variability in pecan orchards;
Feb. 1, 2020: Jim I., P in calcareous soils;
Alternate: Haiying Tao

Planning of 2020 WERA-103 (non-conference) Meeting

Hawaii and New Mexico were both considered as locations for the 2020 meeting. The meeting was in Hawaii (Maui) in 2014 and was in New Mexico in 2008. Chair Eric called for a vote and Hawaii won.

Dates considered for the meeting include the weeks of March 9, March 16, and March 23. Chair Eric called for a vote and March 9 won by 15 to 14 over March 16. It was noted that earlier is better because field work is starting at many locations by mid March.

In summary, **the next WERA-103 meeting will be during the week of March 9, 2020, in Hawaii.** The Executive committee will work with Jonathan to arrange details, and will arrange a conference call later this year.

State Reports (see appendix 4)

Administrative Advisor Report (Rich Koenig)

The next annual report is due within 60 days after the annual meeting, to be prepared by Jay Norton, secretary during the meeting. Rich and Eric provided materials and examples to support this. The report includes a 3-page narrative emphasizing impacts, and appendices that include state reports, a group photograph, and examples of durable products. Clain volunteered to review the report before submittal.

Rich noted that WERA-103 is one of over 300 multistate projects. Universities are required to spend a percentage (what %?) of USDA formula funds on multistate activities. The procedure to join multistate projects, including WERA-103 includes completing an Appendix E via Rich or a participating university Ag Experiment Station or Extension office. Then the applicant is added to the NIMMS database. [Note: regular WERA-103 attendees who are not currently listed as members on the NIMMS database include Alan, Jason, and Rob M.]

Rich was asked about the difference between WERA projects and multistate research projects that is recognized by some universities, notable Oregon State and Wyoming, and he said that there is no difference. He suggested that Extension programs at those institutions need to also invest formula funds along with the Ag Experiment Stations, and that the programs should emphasize multistate research AND extension efforts.

Rich explained that his role as administrative advisor is to ensure that the group meets once per year, takes minutes, has a leadership structure, and follows other guidelines.

WERA-103 Renewal Proposal Due January 15, 2020 (Rich Koenig)

Report will be prepared by the executive committed along with volunteers Urszula, Amber, and Clain.

WERA-103 has existed for 25 years and is a highly successful multistate project because of:

- Much individual involvement by members;
- Membership, involvement by USDA-ARS, industry, and non-land grant universities;
- Development of products, including:
 - The analytical methods manual;
 - Contributions to Tri Society publications;
 - Webinars, etc.
- Multi-state collaborative projects;

Past reviews have been very positive, including the 2015 one:

- Extension efforts: excellent;
- Research efforts: excellent;
- Academic efforts (teaching): needs improvement.

But, this is still excellent because no groups excel in all three; many focus only on research, for example.

The Renewal process is a long one: after submittal on January 15 it is reviewed internally by the association of agricultural experiment station directors, then externally by selected administrators. Ag Experiment Directors vote on whether to approve in March (2020) and, if approved, the new WERA-103 will be effective as of October 1, 2020.

Asked about the success rate for renewal proposal, Rich responded that traditionally “these sail through with reasonable effort”, but more recently there have been more denials due to tighter funding. Rich provided materials and the successful 2015 proposal in support.

Jim I. noted that the proposal should emphasize the classroom teaching value of the webinars (recorded by Rob M.) and other efforts, like the WSARE-funded videos produced by Rob F., Jim W., and Joan.

In 2015 the executive committee made up of Joan, Galen, and Jim W. wrote the renewal proposal, updating the 2010 version. They indicated that it is nine pages long, took about two days of work, and the 2020 one should be easily adaptable from the 2015 proposal and should emphasize impacts.

Discussion of Webinars recorded by Rob M.

Rob M. said that his goal was to get information out and it was easy because he was already recording IPNI webinars. David set up the YouTube channel, but viewership is low. The effort needs more promotion. People should subscribe to the YouTube channel, and place links to it on other educational Websites, share with contacts, clientele, etc. Rob M. is willing to continue with another set of recordings this year. 10 webinars have been produced by WERA-103 members so far (listed in appendix ___, meeting powerpoint). Rob M. passed around a signup sheet and the monthly openings quickly filled for 2019. Rob M. will contact those who signed up. (should this be listed here?)

Discussion of WERA-103 accomplishments (see report narrative and state reports)

Meeting was adjourned at 3:30, followed by short meeting of the “Future of the WNMC Subcommittee”.

Appendix 3. Financial History

| Western Nutrient Management Conference Financial History | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|
| | 2019 | 2017 | 2015 | 2013 | 2011 | 2009 |
| Total Attendance | | 132 | 130 | 129 | 90 | 62 |
| Prepaid registrants | | 6 | 16 | 24 | 17 | 7 |
| Prepaid registrants - cc | | 86 | 79 | 67 | 50 | 37 |
| Late registrants | | 2 | 2 | 2 | 3 | 1 |
| Late registrants - cc | | 20 | 9 | 15 | 6 | 5 |
| Student | | 0 | 13 | 7 | 5 | 10 |
| Students - cc | | 9 | 7 | 10 | 7 | 1 |
| Credit Cards | | 0 | 0 | 0 | 0 | 0 |
| Comps: Speaker/media/student/committee | | 9 | 4 | 2 | 1 | 1 |
| Misc | | 0 | 0 | 2 | 1 | 0 |
| WCC | | 26 | 26 | 26 | 23 | 25 |
| Registration Fees | | | | | | |
| Early Bird registration - cc | 150 | 150 | 125 | 125 | 125 | 125 |
| Pre-registration - cc | | 150 | 150 | 150 | 150 | 150 |
| Regular registration - cc | 175 | 175 | 150 | 150 | 150 | 150 |
| Late registration - cc | | 175 | 155 | 155 | 155 | 155 |
| Student - cc | 50 | 50 | 50 | 50 | 50 | 50 |
| Student - cc | | 50 | 55 | 55 | 55 | 55 |
| Credit Card Fee | | 0 | 5 | 5 | 5 | 5 |
| WCC | | 60 | 60 | 50 | 50 | 50 |
| Income | \$ 3,296.88 | \$ 22,719.00 | \$ 19,225.00 | \$ 18,557.00 | \$ 14,391.00 | \$ 9,177.00 |
| Registration | | | | | | |
| Pre-registration | | \$ 13,800.00 | \$ 12,270.00 | \$ 11,710.00 | \$ 8,625.00 | \$ 5,685.00 |
| On-site registration | | \$ 3,850.00 | \$ 1,695.00 | \$ 2,625.00 | \$ 1,380.00 | \$ 925.00 |
| Student | | \$ 450.00 | \$ 1,035.00 | \$ 900.00 | \$ 635.00 | \$ 555.00 |
| Credit Card | | \$ - | \$ - | \$ - | \$ - | \$ - |
| WCC | | \$ 1,560.00 | \$ 1,560.00 | \$ 1,300.00 | \$ 1,150.00 | \$ 1,250.00 |
| Proceeding Sales | | \$ 75.00 | \$ 25.00 | \$ 340.00 | \$ 430.00 | \$ 360.00 |
| Sponsors | | \$ 2,700.00 | \$ 2,100.00 | \$ 1,450.00 | \$ 2,150.00 | \$ 400.00 |
| Memorial | | \$ - | \$ 510.00 | | | |
| Misc. | | \$ - | \$ 30.00 | \$ 203.00 | | |
| WERA Planning Mtg | \$ 3,296.88 | \$ 284.00 | \$ - | \$ 29.00 | \$ 21.00 | \$ 2.00 |
| Expenses | \$ 3,612.34 | \$ 19,516.17 | \$ 16,786.00 | \$ 14,488.00 | \$ 12,708.00 | \$ 8,729.00 |
| Administrative | \$ 138.99 | \$ 6,013.17 | \$ 2,998.00 | \$ 3,410.00 | \$ 3,008.00 | \$ 1,340.00 |
| Credit Card | | \$ 580.00 | \$ 476.00 | \$ 384.00 | \$ 249.00 | \$ 184.00 |
| Office supplies | \$ 138.99 | \$ 201.17 | \$ 40.00 | \$ 442.00 | \$ 259.00 | \$ 268.00 |
| Misc | | \$ 383.00 | \$ - | \$ 50.00 | \$ 125.00 | \$ - |
| Coordinator | | \$ 1,949.00 | \$ 682.00 | \$ 734.00 | \$ 675.00 | \$ 888.00 |
| Web host | \$ - | \$ 2,900.00 | \$ 1,800.00 | \$ 1,800.00 | \$ 1,700.00 | \$ - |
| Hotel | \$ - | \$ 9,099.00 | \$ 8,463.00 | \$ 8,317.00 | \$ 6,999.00 | \$ 6,331.00 |
| Breakfast | | \$ 4,480.00 | \$ 3,923.00 | \$ 3,923.00 | \$ 3,500.00 | \$ 3,127.00 |
| Barquet | | \$ 3,206.00 | \$ 3,126.00 | \$ 3,098.00 | \$ 2,286.00 | \$ 1,682.00 |
| Room Rental | | \$ (237.00) | \$ (277.00) | \$ (538.00) | \$ (303.00) | \$ - |
| AV | | \$ 525.00 | \$ 640.00 | \$ 625.00 | \$ 580.00 | \$ 398.00 |
| WCC Room/AV | | \$ 45.00 | \$ 45.00 | \$ 77.00 | \$ 45.00 | \$ 71.00 |
| WCC Food | | \$ 1,080.00 | \$ 1,006.00 | \$ 1,132.00 | \$ 891.00 | \$ 1,053.00 |
| Proceedings | | \$ 2,578.00 | \$ 2,637.00 | \$ 1,480.00 | \$ 1,390.00 | \$ 1,058.00 |
| Speakers | | \$ 892.00 | \$ 1,242.00 | \$ 300.00 | \$ 380.00 | \$ - |
| Leadership Award | | | | | | |
| Student Programs | | \$ 934.00 | \$ 1,443.00 | \$ 981.00 | \$ 931.00 | \$ 931.00 |
| Adjustments | | | | | | |
| WERA Planning Mtg | \$ 3,473.35 | \$ - | \$ 3.00 | | | |
| Net Income/Loss | \$ (315.46) | \$ 3,202.83 | \$ 2,439.00 | \$ 4,069.00 | \$ 1,683.00 | \$ 448.00 |
| Interest Income | | \$ - | \$ - | \$ 8.00 | \$ 20.00 | \$ 87.00 |
| Bank Charges/Adjustments | \$ (44.00) | \$ (20.69) | | | | |
| Ending Bank Balance | \$ 20,813.68 | \$ 21,173.14 | \$ 17,991.00 | \$ 15,552.00 | \$ 11,475.00 | \$ 9,772.00 |

Appendix 4

WERA-103 2018 State Reports

ALP-MAP-CAP Proficiency Programs, SPAC

Submitted by Robert Miller, Colorado State University, Programs Coordinator

ALP Program

The Agricultural Laboratory Proficiency (ALP) program had one hundred seventeen laboratories enrolled in 2018. It is the only accredited proficiency provider under ISO/IEC 17043 by ANAB for agricultural lab testing in North America. New laboratory participants were enrolled in 2018 from California, Mid Atlantic region and Canada. Additional warehouse space was added for the 165 soils the program has archived for future use in the program along with 2017 soil collections from: WV, NC, SC, GA, KY, OR, MN, and MI.

Accreditation of the ALP program was renewed with ANAB in September 2018. Collaboration with the Illinois Soil Testing Association Laboratory Accreditation Program (ISTA-LAP). ALP was a sponsor at: the 2018 Mid-Atlantic soil meeting in February and the SERA-6 Soil Meeting in Athens, GA in June 2018. Twenty-one laboratory site visits were conducted during 2016. An ALP lab tour is scheduled for March 2018 of labs in the Pacific Northwest.

We conducted a 3 day soil testing lab tour in August 2017 of soil testing labs in the Midwest. We had 12 participants and visited four labs and precision Ag center in eastern Ohio.

March 5, 2019, the Soil and Plant Analysis Council held a 1 day lab Workshop in Turlock, CA. Topics covered soil CEC, Lab analysis proficiency, client relations, soil health methods, nitrate analysis methods, ICP instrumentation, soil cadmium and vegetable production and combustion nitrogen instruments. We had 30 participants representing 9 laboratories.

Last we have another 3 day lab tour scheduled for in the Pacific North West of four soil testing labs, an ethanol plant and a winery. We have 9 participants signed up.

MAP and CAP Programs

The Manure Analysis Proficiency (MAP) administered by the Minnesota Department of Agriculture (MDA) program has 74 labs enrolled. Certification is required for labs providing dairy manure analysis in California and labs providing manure testing NRCS 590 requirements for nutrient management.

The Compost Analysis Proficiency (CAP) program has seventeen laboratories enrolled. There was new collaboration with the United States Compost Council and the Canadian Compost Workgroup. Method revisions have been completed on the USCC publication Test Methods for the Examination Composting and Compost, United States Compost Council (USCC) by Wayne Thompson.

Research, Manuscripts and Awards

Research studies. Lab evaluation of the CO₂ Solvita burst method was completed. Results utilizing ALP soils show issues associated with optimization of O₂, effects of texture and instability of the method.

Midwest corn K fertility research continues with support from WinField Solutions, CanGro, Fluid Fertilizer Foundation, and Nachurs. In 2018 36 observation sites were installed grower fields across seven Midwestern States to assess soil and plant K fertility. Cluster analysis of ear leaf analysis from 181 site years K concentrations less than 1.7% have results in 45 bu/ac lower corn yields over six years. Sites with low ear leaf K showed elevated ear leaf Mg and substantially higher stalk Mg at crop maturity. Eleven presentations on K fertility 2018.

Manuscripts: [A Simple Non-Instrumental Procedure for Soil Microbial Biomass Carbon Measurements](#) . Yuch-Ping Hsieh, George A. Anderson, Robert O. Miller, Djanan Nemours and Lucretia Sherrod, was accepted for publication, SSSAJ.

Abstract Presentations. Two presentations were made at the Soil Conservation meetings in Albuquerque July 29-31, 2018, on soil respiration methods and an assessment of compost effects.

Awards. Werner L. Nelson Award, Fluid Fertilizer Foundation, 2018. In Recognition of outstanding contributions in the development of soil fertility practices and plan nutrition management to increase crop yields for the benefit of the North American farmer and consumer. Presented at the Fluid Fertilizer Forum, Scottsdale, AZ February 20, 2018.

Soil and Plant Analysis Council Activities

The 16th ISSPA meeting is scheduled for June 17-20th, 2019, in Wageningen, The Netherlands in conjunction with ASPAC of Australia-New Zealand. SPAC elected Leticia Sonon, of Actagro as its new president elect and add three new board Members for the 2018-2020 term. The 17th ISSPA meeting is being organized for 2021 in Vancouver, Canada.

Arizona WERA-103 report

Submitted by Jim Walworth, University of Arizona

Publications

Askari-Khorasgani, O., Mortazaienezhad, F., Zeinali, H., & Pessarakli, M. (2018). Interactive Effects of Saline Irrigation Water and Genotypes on Nutrient Composition of Chamomile (*Matricaria recutita* L.). *Journal of Plant Nutrition*, 41(1), 9.

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Research

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Archer, Steven. Can Biological Soil Crusts Inhibit Germination or Establishment of Invasive Grasses in Southwestern Rangelands, United States Department of Agriculture

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Blankinship, Joseph, Phillips, Mary-Madison, Jones, Julia. Waste Diversion, Water Savings, and Carbon Sequestration via Biochar, University of Arizona Green Fund

Blankinship, Joseph, Rasmussen, Craig, Fehmi, Jeffrey, Blowers, Paul. Using Biochar to Sequester Soil Carbon and Promote Sustainability in Arizona, RDI Start For Success Program

Blankinship, Joseph, Thompson, Aaron, Heckman, Katherine, Lawrence, Corey, Crow, Susan, Keiluweit, Marco, Swanston, Christopher. Soil Organic Matter Data Synthesis and Visualization Working Group, USDA AFRI Foundational Program

Blankinship, Joseph. An Urgent Need for Improved Understanding of Soil Aggregate Dynamics in Arid Ecosystems, CALS Early Career Faculty Seed Grant

Blankinship, Joseph. Launching the Arizona Carbon Project: Soil Organic Carbon Accounting and Sequestration in the Sonoran Desert, CALS Innovation Venture Investment Program

Blankinship, Joseph. What Lies Below? Improving Quantification and Prediction of Soil Carbon Stability, and Susceptibility to Disturbance, United States Geological Survey

Brown, Paul, Sanchez, Charles, Brierley, Paul. Quantitative Assessments of Water and Salt Balance for Cropping Systems in Lower Colorado River Irrigation Districts, Yuma County Agricultural Water Coalition

Brown, Paul, Walworth, James, Papuga, Shirley. Quantifying Variability in Arizona Pecan Water Use, United States Department of Agriculture; Arizona Department of Agriculture

Carini, Paul. Adaptive Strategies in a Cosmopolitan and Abundant Soil Bacterium: Genetic Microdiversity or Core Metabolic Flexibility, Joint Genome Institute

Carini, Paul. Roles of Obligate Oligotrophic Bacteria from Arid Unclaimed Mine Tailings Sites. Center for Environmentally Sustainable Mining

Carini, Paul. Genomes, Transcriptomes and Metabolomes of Novel Actinobacteria from Oligotrophic Subsurface Soils, Joint Genome Institute

Carini, Paul. Illuminating Subsurface Microbial Dark Matter, University of Arizona College of Agriculture & Life Sciences Early Career Faculty Seed Grant

Chorover, Jon, Brusseau, Mark, Maier, Raina. Upscaling Hydrobiogeochemical Mechanisms to Predict Reactive Transport and Site Remediation during Phytostabilization of Mine Tailings, National Institute of Environmental Health Sciences, NIH

Chorover, Jonathan, Dontsova, Katerina. Stabilization of Organic Carbon Complexation with Iron Colloids Formed During Biogeochemical Weathering of Basalt, DOE - Environmental Molecular Sciences Laboratory (EMSL)

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Gallaher, Joanne, Artiola, Janic, Glenn, Edward. Reverse Osmosis Concentrate Management through Halophyte Farming – Halophyte Farming for the Management of Concentrates from Inland Reverse Osmosis Desalination Facilities, Bureau of Reclamation

Gallery, Rachel, Rasmussen, Craig, Fehmi, Jeffrey. Impact of Soil Biotic Community, Low Rainfall, and Amendments on Mineland Revegetation. Rosemont Copper Company

Gerba, Charles, Bright, Kelly, Ravishanker, Sadhana. Control of Contamination of Organically Grown Foods

Gerba, Charles, Daun, Jennifer. Irrigation Sediments as a Reservoir for Pathogens, Arizona Department of Agriculture

Gerba, Charles, Duan, Jennifer. Development of a Model to Predict the Impact of Sediments on Microbial Irrigation Water Quality, United States Department of Agriculture, Center for Produce Safety

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Mcguire, Luk, Rasmussen, Craig, Youberg, Ann. From Source to Sink: Identifying Hot Spots for Debris Flow Hazards and Soil Carbon Sequestration Following Wildfire, WEES and UA RDI

Moore, David. Ecosystem Water and Carbon Cycling Across the Semiarid Western U.S., Agricultural Research Service

Niu, Guo-Yue, Chorover, Jonathan, Troch, Peter, Dontsova, Katerina. Collaborative Research: Coupled Hydrological and Geochemical Process Evolution at the Landscape Evolution Observatory, National Science Foundation

Norton, Elbert. Evaluation of Several Fertility and Soil Amendment Treatments, AgroDyne Solutions

Ottman, Michael, Andrade Sanchez, Pedro. Tools for Nitrogen Management of Wheat (19-01), Arizona Grain Research and Promotion Council

Ottman, Michael, Frisvold, George, Andrade Sanchez, Pedro, Brierley, Paul. Nitrogen Management and Water Footprint for Arizona Durum Production, Barilla USA

Papuga, Shirley, Walworth, James, Brown, Paul. Eddy Covariance System for Quantifying Water Use of AZ Pistachio Orchards, UA Water, Environmental, and Energy Solutions

Rock, Channah. Predicting the Quality of Surface Water Used for Irrigation Using Field-collected Hydrological Data, and Remotely-sensed Landscape and Meteorological Data in New York State and Arizona, Center for Produce Safety, Cornell University

Sanchez, Charle, Brierley, Paul. Quantitative Assessments of Water and Salt Balance for Cropping Systems in Lower Colorado River Irrigation Districts, Bureau of Reclamation

Sanchez, Charles, Brierley, Paul. Evaluation of Soil Moisture Sensor Technologies in Desert Vegetable Cropping Systems, Western Growers Association

Sanchez, Charles, Brierley, Paul. Evapotranspiration from Desert Iceberg Lettuce Production Systems, Arizona Iceberg Lettuce Research Council

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Sanchez, Charles, Brierley, Paul. Measuring Evapotranspiration of Lemons, Arizona Citrus Research Council

Sanchez, Charles, Brierley, Paul. Satellite Measurement of Evapotranspiration (ET) from Desert Iceberg Lettuce Production Systems, Arizona Iceberg Lettuce Research Council

Sanchez, Charles, Brierley, Paul. Spinach Water and Salt Management, United States Department of Agriculture, Arizona Department of Agriculture

Sanchez, Charles, Brierley, Paul. Water and Salt Management for Melons, United States Department of Agriculture, Arizona Department of Agriculture

Sanchez, Charles. Continued Mitigation of Heavy Metals, United States Department of Agriculture, Arizona Department of Agriculture

Sanchez, Charles. Efficient Water and Nitrogen Management Practices for Mixed Leafy Baby Green Vegetables in the Desert, California Department of Food and Agriculture

Sanchez, Charles. Field Evaluation and Demonstration of Controlled Release N Fertilizers in the Western United States, California Department of Food and Agriculture

Sanchez, Charles. Protocol Field Trials Fertigation Embedded GE/ X Factors in WSF, Everris NA Inc.

Sanchez, Charles. Zinc Nutrition of Desert Vegetables, United States Department of Agriculture, Arizona Department of Agriculture

Schaap, Marcel. Colloid Mobility in Soils: Fundamental Pore-Scale Mechanisms, Simplifications and Practical Relevance for Risk Analysis, United States Department of Agriculture

Tfaily, Malak. Illuminating the Pathways to Carbon Liberation: A Systems and Modeling Approach To Resolving the 'Consequential Unknowns' Of Carbon Transformation and Loss from Thawing Permafrost Peatlands, United States Department of Energy, Battelle Memorial Institute

Tfaily, Malak. Root Influences on Mobilization and Export of Mineral Bound Soil Organic Matter, United States Department of Energy, University of Massachusetts Amherst

Tuller, Markus, Andrade Sanchez, Pedro. Novel Approaches to Remote Sensing of Earth Surface Properties and Processes Applicable to Agricultural and Natural Resources Management, CALS Innovation Venture Investment (iViP) Program

Tuller, Markus. Collaborative Research: Novel in Situ Measurement and Remote Sensing Techniques for Characterization of Near-Surface Soil Hydrology, National Science Foundation

Walworth, James, Sherman, Joshua. Nickel Nutrition of Arizona Pecans, United States Department of Agriculture, Arizona Department of Agriculture

Walworth, James. Arizona Pecans: Integrated Fertilizer Management, United States Department of Agriculture, Arizona Department of Agriculture

Walworth, James. Improved Nutrient Management for Arizona Pecans, United States Department of Agriculture, Arizona Department of Agriculture

Wright, Glenn, Walworth, James, Carriere, Yves, Pryor, Barry, Chorover, Jonathan, Abrell, Leif. Central Date Palm Laboratory Project, Omani Authority for Partnership for Development

Colorado WERA-103 report

Submitted by Jim Ippolito, Colorado State University

Soil-based use of biosolids and manures for enhancing soil fertility; Ippolito, J.A., Delgado, J., Miner, G., Bordi, K. Objectives: 1. Evaluate the short- and long-term chemistry and bioavailability of inorganic trace elements, organic micro-constituents and nutrients in residuals, reuse water and amended soil in order to assess the environmental and health risk-based effects of their application to uncontaminated soil. 2. Evaluate the agronomic and environmental benefits/advantages of land applying residual by-products and/or substituting such materials as fertilizers. Contact: jim.ippolito@colostate.edu

Soil-based use of biosolids for improving soil health; Ippolito, J.A., Bordi, K., Buchanan, C. Objectives: 1. Evaluate the long-term effects of biosolids and/or inorganic fertilizer application on soil physical, chemical, nutrient, and biological soil health, and overall soil quality; 2. Determine these effects under increasing amendment or fertilizer application rates or at agronomic rates in wheat-fallow or wheat-corn fallow agroecosystems, or under rangeland application. Contact: jim.ippolito@colostate.edu

Phosphorus capture, recycling, and utilization for sustainable agriculture; Ippolito, J.A., Banet, T., Litaor, I., Zohar, I. Objectives: 1. Utilize municipal drinking water treatment facility residuals to remove organic P from swine wastewater and quantify removal efficiency; 2. Study the created residual-organic P composite material for its potential to act as a P fertilizer source as compared to commercial P fertilizer. Contact: jim.ippolito@colostate.edu

Developing nitrogen response curves for higher yielding wheat varieties: Improving grain yield and protein content; Johnson, J., Jones, S., Ippolito, J., Tyler, R., Shelnut, S., Haley, S. Objectives: 1. To provide reliable and unbiased nitrogen yield and protein response information to eastern Colorado farmers for each of three newly released, higher yielding winter wheat varieties under dryland conditions; 2. To determine optimum agronomic and economic nitrogen fertilization rates at each of ten trial locations or for groups of locations for both yield and protein content; 3. yield and protein response to nitrogen in combination with sulfur will be determined for one of the varieties, Snowmass 2.0. Intense environmental monitoring of weather and soil variables will lead to information about why some locations, or varieties, respond to nitrogen or sulfur fertilization and other locations do not. Contact: jerry.johnson@colostate.edu; jim.ippolito@colostate.edu

Biochar use for reducing irrigation water salinity concentrations; Ippolito, J.A., Awan, S. Objectives: 1. To determine whether various biochars created from different feedstocks (and thus contain various characteristics such as negative surface charge or functional groups) can sorb elements from saline waters, thus reducing salinity. This project is geared mainly towards irrigation waters in Pakistan, but findings may play a pivotal role globally. Contact: jim.ippolito@colostate.edu

Biochar use for reducing heavy metal, nutrient, and trace organic concentrations in contaminated soils; Ippolito, J.A., Cui, L. Objectives: 1. Utilize various biochars to reduce Cd, Pb, Zn, Cu, and Mn concentrations in soils highly contaminated by past/current anthropogenic activities; 2. Utilize biochars to reduce agroecosystem N losses; 3. Utilize biochar to reduce halogens and 2,4,6-trichlorophenol contamination in soils. The goal of both these projects is to reduce (in)organic contamination in soils to allow for improvements in crop productivity and reduce human and environmental health risk. Contact: jim.ippolito@colostate.edu

Publications:

Cui, L., L. T. Chen, C. Yin, J. Yan, J.A. Ippolito, and Q. Hussain. 2018. Mechanism of adsorption of cadmium and lead ions by iron-activated biochar. *Bioresour.* 14:842-857.

Tian, X.M., H. Fan, F.H. Zhang, K.Y. Wang, J.A. Ippolito, J.H. Li, Z.W. Jiao, Y.B. Li, Y.Y. Li, J.X. Su, W.T. Li, and M.J. An. 2018. Soil carbon and nitrogen transformations under soybean as influenced by organic farming. *Agronomy J.* 110:1883-1892.

Borchard, N., M. Schirrmann, M. Cayuela, C. Kammann, N. Wrage-Mönnig, J.M. Estavillo, T. Fuertes-Mendizabal, G. Sigua, K. Spokas, J.A. Ippolito, and J. Novak. 2018. Biochar, soil and land use interactions that reduce nitrate leaching and N₂O emissions: A meta-analysis. *Sci. Tot. Environ.* 651:2354-2364.

Miner, G.L., J.A. Delgado, J.A. Ippolito, K.A. Barbarick, C.E. Stewart, D.K. Manter, S.J. Del Grosso, A.D. Halvorson, B. Floyd, and R. D'Adamo. 2018. Influence of long-term nitrogen fertilization on crop and soil micronutrients in a no-till maize cropping system. *Field Crops Res.* 228:170-182.

Massey, M.S., I. Zohar, J.A. Ippolito, and I.M. Litaor. 2018. Phosphorus sorption to aluminum-based water treatment residuals reacted with dairy wastewater: 2. X-ray absorption spectroscopy. *J. Environ. Qual.* 47:546-553.

Zohar, I., Litaor, M.I., J.A. Ippolito, and M. Massey. 2018. Phosphorus sorption characteristics in aluminum-based water treatment residuals reacted with dairy wastewater, 1: Isotherms, XRD and SEM-EDS analysis. *J. Environ. Qual.* 47:538-545.

Novak, J.M., J.A. Ippolito, T.F. Ducey, M.G. Johnson, D.W. Watts, K.M. Trippe, K.A. Spokas, and G.C. Sigua. 2018. Remediation of an acidic mine spoil: Miscanthus biochar and lime amendment affects metal availability, plant growth, and soil enzyme activity. *Chemosphere.* 205:709-718.

Ippolito, J. 2018. Colorado winter wheat and sulfur fertility. In (J. Johnson et al.) Making better decisions: 2017 Colorado winter wheat variety performance trials. Colorado Ag. Exp. Sta. TR 2018 Wheat Field Days Edition.

Barbarick, K.A., J.A. Ippolito, J.M. McDaniel, and K. Diaz. 2018. Agronomic N fertilizer vs. biosolids applications, 1994-2014. Colorado Ag. Exp. Sta. TR18-3.

Ippolito, J. 2018. How does biochar work to improve, or even decontaminate, soil? Soils matter, get the scoop! blog. Soil Science Society of America. Available at: <https://soilsmatter.wordpress.com/2018/02/15/how-does-biochar-work-to-improve-or-even-decontaminate-soil/>.

Banet, T., J. Ippolito, M. Massey, I. Zohar, and I. Litaor. 2018. Aluminum water treatment residuals can capture organic phosphorus to be used as a potential plant-available source. Proc. Of the Great Plains Soil Fertility Conference. Denver, CO. March 6-7. Denver, CO

Presentations:

Ippolito, J.A. 2018. Soil quality/soil health: Irrigation and organic amendment perspectives. Eastern Colorado Crop Production Conference. Fort Morgan, CO. Dec. 5-6.

Ippolito, J.A., and D. Tarkalson. 2018. Introduction to Soils Seminar. American Society of Farm Managers and Rural Appraisers – California Chapter. November 13. Lodi, CA.

Ippolito, J.A., and J-C Liu. 2018. Biochars abiotically alter iron redox chemistry. American Society of Agronomy Meetings. November 4-7. Baltimore, MD.

Novak, J.M. D.W. Watts, G.C. Sigua, T.F. Ducey, H. Rushmiller, J.A. Ippolito, M.G. Johnson, and K.A. Spokas. 2018. Maize productivity, heavy metal uptake, and health responses in a contaminated mine spoil as affected by different biochar types. American Society of Agronomy Meetings. November 4-7. Baltimore, MD.

Banet, T., J. Ippolito, M. Massey, I. Zohar, and I. Litaor. 2018. Aluminum water treatment residuals retain organic phosphorus that may be used as a potential plant-available source. American Society of Agronomy Meetings. November 4-7. Baltimore, MD.

Miner, G.L., J.A. Delgado, J.A. Ippolito, K.A. Barbarick, C.E. Stewart, D.K. Manter, S.J. Del Grosso, A.D. Halvorson, B.A. Floyd, and R.E. D'Amado. 2018. Long-term nitrogen fertilization rates affect crop micronutrient concentrations but not soil micronutrient availability. American Society of Agronomy Meetings. November 4-7. Baltimore, MD.

Ippolito, J.A. 2018. Ag on the Plaza – soils demonstrations. Colorado State University. September 19.

Ippolito, J.A., K. Barbarick, and T. Ducey. 2018. Can long-term biosolids land application positively alter soil quality? 31st Annual BioFest – Biosolids Conference. Lake Chelan, WA. September 9-11.

Ippolito, J.A. 2018. The importance of properly soil sampling. 31st Annual BioFest – Biosolids Conference. Lake Chelan, WA. September 9-11.

Novak, J.M., G.C. Sigua, J.A. Ippolito, R.D. Lentz, R.S. VanPelt, K.A. Spokas, K. Sistani, H.P. Collins, M.G. Johnson, and K. Pantuck. 2018. Biochar utilization for soil quality improvement, greenhouse gas reduction, metal and nutrient sequestration. USBI Biochar 2018. Wilmington, Delaware. August 20-23.

- Novak, J.M., J.A. Ippolito, and M.G. Johnson. 2018. Coordinating engineered biochar production for soil quality improvement, mine spoil reclamation, and nutrient removal in waste streams. 4th International Conference on Contaminated Land, Ecological Assessment and Remediation. Hong Kong, China. August 16-18.
- Novak, J.M., J.A. Ippolito, and M.G. Johnson. 2018. Coordinating engineered biochar production for soil quality improvement, mine spoil reclamation, and nutrient removal in waste streams. 2018 International Conference on Heavy Metals in the Environment. University of Georgia, Athens, Georgia. July 21-25.
- Ippolito, J.A., and K.A. Barbarick. 2018. Can long-term biosolids land application positively alter soil quality? W3170 Beneficial Reuse of Residuals and Reclaimed Water: Impact on Soil Ecosystem and Human Health Annual Conference. Chicago, IL. June 24-26.
- Ippolito, J.A. 2018. Evaluation of time-bomb effect: metals availability after the cessation of long-term biosolids land application in Colorado. W3170 Beneficial Reuse of Residuals and Reclaimed Water: Impact on Soil Ecosystem and Human Health Annual Conference. Chicago, IL. June 24-26.
- Ippolito, J.A. 2018. Short- and long-term composted biosolids land applications affect grassland soils and plants. 2nd International Conference on Bioresources, Energy, Environment, and Materials Technology. Hongcheon, Gangwon Province, South Korea. June 10-13.
- Ippolito, J.A., L. Cui, J. Novak, and M. Johnson. 2018. Biochar-heavy metal sorption mechanisms in contaminated soils. 2nd International Conference on Bioresources, Energy, Environment, and Materials Technology. Hongcheon, Gangwon Province, South Korea. June 10-13.
- Ippolito, J.A., and K.A. Barbarick. 2018. Meta-analysis of biosolids effect in dryland wheat agroecosystems. 2nd International Conference on Bioresources, Energy, Environment, and Materials Technology. Hongcheon, Gangwon Province, South Korea. June 10-13.
- Ippolito, J.A. 2018. Strategies to combat environmental stress in arid lands. Aridland Crop Summit. Gansu Agricultural University. Gansu Province, China. May 28-June 1.
- Jalali, S., N. Roman-Muniz, S. Archibeque, T. Holt, J. Ippolito, and T.E. Engle. 2018. Extracting copper from dairy footbaths to prevent heavy metal bioaccumulation in agricultural land – A proof of concept study. JBS Corp. Greeley, CO. May 14.
- Jalali, S., N. Roman-Muniz, S. Archibeque, T. Holt, J. Ippolito, and T.E. Engle. 2018. Used footbath copper extraction, and CuSO₄ recycling apparatus design and feasibility study. CSU Demo Day, CSUVentures. Fort Collins, Colorado April 10.
- Ippolito, J.A. 2018. Mining, Reclamation, Plant Productivity, and Livestock Production Implications. 255th American Chemical Society National Meeting & Exposition. New Orleans, LA. March 18-22.
- Ippolito, J.A. 2018. Biochar's benefits for western US soils. March 9. University of Wyoming, Department of Plant Sciences seminar series.

Ippolito, J. 2018. Can irrigation method affect soil phosphorus availability? Great Plains Soil Fertility Conference. Denver, CO. March 6-7.

Banet, T., J. Ippolito, M. Massey, I. Zohar, and I Litaor. 2018. Aluminum water treatment residuals can capture organic phosphorus to be used as a potential plant-available source. Great Plains Soil Fertility Conference. Denver, CO. March 6-7.

Ippolito, J.A. 2018. Science of biosolids land application. West Adams County Conservation District Biosolids Workshop. Brighton, CO. February 28.

Ippolito, J.A. 2018. Biochar magic?: How can biochar improve soil processes? American Society of Agronomy/Soil Science Society of America Webinar. Madison, WI. February 27.

Ippolito, J.A. 2018. Biochar: A local product for solving local problems. TriBeta Biology Honor Society Lectureship, Colorado State University Chapter. February 12.

Ippolito, J.A. 2018. Soil health/soil quality. Morgan Conservation District's 63 Annual Meeting. Fort Morgan, CO. February 8.

HAWAII WERA-103 report

Submitted by Jonathan L. Deenik, University of Hawaii,

Soil Science Update at the University of Hawaii

Administration

Dr. Walter Bowen was named new Associate Dean and Associate Director for Research (January 2019)

Retirements

Dr. Russell Yost, soil scientist, retired December, 2018

Alton Arakaki, Extension Agent on Molokai, retired December, 2018

Dr. Skip Bittenbender, Specialist, retired January, 2018

Research Update

Breadfruit – Dr. Lincoln continues to characterize environmental (climate, soil type) effects on breadfruit growth, yield, and fruit quality across its range of environments in Hawaii. The study combines greenhouse experiments, field trials, and citizen science approaches with numerous breadfruit growers across the state.

CropManage Hawaii – Drs Deenik and Bateni continue to collaborate with Dr. Cahn (UC Davis) to adapt the CropManage online irrigation scheduling decision support tool to Hawaii, Guam and American Samoa vegetable crop lands. Datasets for crop canopy cover and root growth dynamics have been completed for

various high value vegetable crops grown on Hawaii, Maui, and Oahu. Once the algorithms have been updated and Hawaii weather stations integrated into the software, side-by-side experiments comparing current farmer irrigation practices and irrigation recommendations from CropManage will be implemented.

Soil Health – Drs Crow and Deenik continue to address soil health testing in Hawaii. A recent MS graduate has identified 9 soil health indicators covering physical, chemical and biological properties that are sensitive across soil type and agroecosystems. A PhD student is now developing scoring functions and an soil health index to enable interpretation.

Web-based Agricultural/Ecological Decision Support System – Dr. Deenik continues to work with Dr. Miura (GIS and remote sensing professor in Department of Natural Resources and environmental Management). Current work is focused on adding crops to the HI-CROP Web Mapper, a GIS-based software to display crop suitability maps for the Hawaiian Islands in the current climate regime and climate 50-100 years in the future. (<http://gis.ctahr.hawaii.edu/CropSuitability>)

The Hawaiian Soil Microbiome – This is a developing project where Dr. Nguyen aims to understand the composition of microbes (and beyond) that live in the diverse soils across the Hawaiian Islands in both managed and natural systems. The project (combined with other ongoing research activities) will contribute the underlying data for the concept of the Hawaiian Soil Microbiome. The first set of experiments are investigating how crop species affects rhizosphere microbial abundance, diversity and function. A graduate student has been hired to implement these studies.

Sustainable and Organic Agriculture Program (SOAP) – Dr. Radovich leads a training program in organic agriculture designed to address small-scale organic farming in Hawaii. Across Hawaii, farmers and ranchers are experimenting with different ways of producing agricultural products, novel approaches which aspire to bring social, economic and environmental well-being to both farm families and to the rural communities in which they live. This type of agriculture simultaneously focuses on three equally important challenges: 1) To provide a more profitable farm income; 2) To promote environmental stewardship; and 3) To promote stable, prosperous farm families and communities. (<https://cms.ctahr.hawaii.edu/soap/Home.aspx>)

Publications

Journal Publications

- Berek, A.K. Berek, Nguyen, N.V., Radovich, T.J.K., and Ahmad, A.A. 2018. Biochars Improve Nutrient Regulation of Highly Weathered Soils. *Agronomy Journal*: (In Press).
- Gangaiah, C., Ahmad, A.A., Smith, C.M., and Radovich, T.J.K. 2018. Potassium Release Kinetics from Three Invasive Algae Mixed with Different Media in Leachate Column Studies. *Journal of Applied Phycology (JAPH)*: (In Press)
- Radovich, T.J.K 2018. Vegetable biology and Classification. In: *Handbook of Vegetables and Vegetable Processing*, 2nd edition. Wiley-Blackwell, Iowa.
- Butnan, S., J.L. Deenik, B. Toomsan, and P. Vityakon. 2018. Biochar properties affecting carbon stability in soils contrasting in texture and mineralogy. *Agriculture and Natural Resources*
<https://doi.org/10.1016/j.anres.2018.03.002>

- Pawlowski*, M., M.N. Meki, J. Kiniry, and S.E. Crow. 2018. Carbon budgets of potential tropical perennial grass cropping scenarios for bioenergy feedstock production on Maui. *Carbon Balance and Management* 13:17. doi:10.1186/s13021-018-0102-8
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- Yu, J., L.M. Deem, S.E. Crow, J.L. Deenik, C.R. Penton. 2019. Comparative Metagenomics Reveals Enhanced Nutrient Cycling Potential After Two Years of Biochar Amendment in a Tropical Oxisol. *Applied and Environmental Biology* (Accepted).
- Langston, B. and N.K. Lincoln. 2018. The role of breadfruit in biocultural restoration and sustainability in Hawaii. *Sustainability* 10(11):3956.
- Ladefoged, T.N., N. Thegn, A. Preston, P.M. Vitousek, O.A. Chadwick, J. Stein, M.W. Graves, and N. Lincoln. 2018. Soil nutrients and pre-European contact agriculture in the leeward Kohala field system, Island of Hawai'i. *Archaeology in Oceania* 53(1):28-40.

IDAHO WERA-103 report

- Improving Nutrient Management for Wheat through Comprehensive Soil and Crop Survey. Walsh O.S., Rogers C., Shafian S., Dari B., and J. McClintick-Chess.
- Precision Crop Sensing & UAV Extension Outreach. Walsh O.S. and S. Shafian.
- Education for Idaho Barley Production. Marshall J., Schroeder K., and Walsh O.S.
- Extension Cereal Nurseries. Marshall J., Schroeder K., and Walsh O.S.
- Assessing Residue Source and Management Practices for Improving Fertilizer Recommendations in Wheat-Based Cropping Systems. Rogers C., Walsh O.S., Dari B., and Shafian S.
- Assessing Residue Source and Management Practices for Improving Fertilizer Recommendations in Barley-Based Cropping Systems. Rogers C., Walsh O.S., Dari B., and Shafian S.
- Nitrogen Response, Uptake and Use Efficiency of Spring Wheat Cultivars. Shafian S., Walsh O.S., and McClintick-Chess J.
- Evaluation of Micronutrients in Winter Wheat. Walsh O.S.
- N-Zone Max Evaluation in Winter Wheat. Walsh O.S.
- N-Zone Max and Contain Evaluation in Winter Barley. Walsh O.S.
- Foliar Fertilizers Evaluation in Corn. Walsh O.S.
- Foliar Fertilizers Evaluation in Beans. Walsh O.S.
- Foliar Fertilizers Evaluation in Peas. Walsh O.S.
- Evaluation of OneUP Foliar Fertilizer in Spring Wheat. Walsh O.S.
- Evaluation of 6-24-6 as a starter fertilizer for potatoes. Thornton, M.K.
- Remote sensing of pink root disease, water stress and nitrogen stress in onions. Beck, K. Thornton, M.K.

Publications:

Research

- Yang, R., X. Liang, J. A. Torrion, O.S. Walsh, K. O'Brien, and Q. Liu. 2018. The Influence of Water and Nitrogen Availability on the Expression of End-Use Quality Parameters of Spring Wheat. *Agronomy*. 8, 257; doi:10.3390/agronomy8110257.

Walsh O.S., S. Shafian, J.M. Marshall, C. Jackson, J.R. McClintick-Chess, S.M. Blanscet, K. Swoboda, C. Thompson, K.M. Belmont, and W.L. Walsh. 2018. Assessment of UAV Based Vegetation Indices for Nitrogen Concentration Estimation in Spring Wheat. *Advances in Remote Sensing*. Doi:10.4236/ars.2018.72006.

Walsh, O.S., S. Shafian, J.R. McClintick-Chess, K.M. Belmont, and S.M. Blanscet. 2018. Potential of Silicon Amendment for Improved Wheat Production. *Plants*. Special Issue. 7(2), 26; doi:10.3390/plants7020026.

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Pishchik V.N., Vorobyev N.I., Ostankova Yu.V., Semenov A.V., Totolian Areg A., Popov A.A., Khomyakov Y.V., Udalova O.R., Shibanov D.V., Vertebny V.E., Dubovitskaya V.I., Sviridova O.V., Walsh O.S., and S. Shafian. 2018. Effect of Combine Use of Bacteria *Bacillus subtilis* and Humic Preparation on Physiological Characteristics of Tomato Plants. *International Journal of Plant and Soil Science*. 22(6): 1-12.

Rosen, C, N. Sun, N. Olsen, M. Thornton, M. Pavek, L. Knowles and N.R. Knowles. 2018. Impact of agronomic and storage practices on acrylamide in processed potatoes. *American Journal of Potato Research* 95:319-327.

Mahler, Robert L. 2018. Preferred Water Resource Information Sources and Learning opportunities in the Pacific Northwest. 2018. Natural Sciences Education. 47:180014. DOI:10.4195/nse2018.07.0014.

Borrelli, Kristy A., G. E. Roesch-McNally, J.D. Wulfhorst, S. D. Eigenbrode, Georgine G. Yorgey, Chad E. Kruger, Laurie L. Houston, Leigh A. Bernacchi and Robert L. Mahler. 2018. Farmers' Trust in Sources of Production and Climate Information and their Use of Technology. *Journal of Extension*, Volume 56, number3, Article 3FEA7.

Tarkalson, D., Bjerneberg, D., and Lentz, D. 2018. Effects of manure history and nitrogen fertilizer rates on sugarbeet production in the Northwest US. *Crop Management*. Online. *Crop Management*. doi: 10.2134/cftm2017.11.0083.

Tarkalson, D.D., and Bjerneberg, D.L. 2018. Static nitrogen management for Northwest U.S. sugar production. *Agriculture & Environmental Letters*. doi: 10.2134/ael2018.01.0001.

Extension publications

Rogers C.W., Dari B., and O.S. Walsh. 2019. Best Management Practices for Minimizing Ammonia Volatilization from Fertilizer Nitrogen Applications in Idaho Crops. Bulletin 927. University of Idaho. 10 pp. (In Print)

Dari B., Rogers C.W., and O.S. Walsh. 2019. Understanding Factors Controlling Ammonia Volatilization from Fertilizer Nitrogen Applications. Bulletin 926. University of Idaho. 8 pp. (In Print)

Walsh O.S., D. Tarkalson, A. Moore, G. Dean, D. Elison, J. Stark, O. Neher, and B. Brown. 2019. Southern Idaho Fertilizer Guide: Sugar Beets. CIS 1174. University of Idaho. 15 pp. (In Print)

Walsh O.S., Kathleen M. Painter, Jordan R. McClintick-Chess, and Steven M. Blanscet. 2019. A Grower's Guide to Successful On-Farm Research. Bulletin 914. University of Idaho. 11 pp. (In Print)

Walsh, O.S., R. Mahler, and T. Tindall. 2019. Soil Sampling. Bulletin 913. University of Idaho. 7 pp. (In Print)

Walsh, O.S., Morishita D., Wenninger, E., Woodhall, J., and S. Shafian. Quick Facts – Idaho Beans. CIS. University of Idaho. 2 pp. (Accepted)

Walsh, O.S. and S. Shafian. Nitrogen Management and Precision Agriculture Adoption in Idaho - Stakeholder Survey Results. BUL. University of Idaho. (Accepted)

Proceedings and Abstracts

UAV-Based Assessment of Nitrogen Response, Uptake, and Use Efficiency of Spring Wheat Cultivars. Walsh O.S., S. Shafian, J. Marshall, C. Jackson, J.R. McClintick-Chess. 2018. *Proc. of the ASA International Annual meetings.*

The Influence of Water and Nitrogen Availability on the Expression of End-Use Quality Parameters of Spring Wheat. Yang, R., X. Liang, J. A. Torrrion, O.S. Walsh, K. O'Brien, and Q. Liu. 2018. *Proc. of the ASA International Annual meetings.*

Walsh O.S., S. Shafian, J.R. McClintick-Chess. 2018. Silicon Amendment in Wheat Production. *Proc. Idaho Nutrient Management Conference.*

Walsh O.S., S. Shafian, J. Marshall, J.R. McClintick-Chess. 2018. UAV-Based Vegetation Indices Can Accurately Estimate Wheat (*Triticum aestivum* L.) Nitrogen Content. *Proc. Idaho Nutrient Management Conference.*

Walsh O.S., S. Shafian, J. Marshall, C. Jackson, J.R. McClintick-Chess. Assessment of Red Edge Based Vegetation Indices Derived from Unmanned Aerial Vehicle for Plant Nitrogen Content Estimation. 2018. *Proc. International Conference on Precision Agriculture.*

Popular Press/Trade Journals/Magazines

Marshall J., K. Schroeder, and O.S. Walsh. 2018. 2017 Idaho Spring Barley Variety Performance Tests and 2015-2017 Yield Summaries. Idaho Grain Magazine. Spring 2018. pp. 23-26.

Marshall J., K. Schroeder, and O.S. Walsh. 2018. 2017 Idaho Spring Wheat Variety Performance Tests and 2015-2017 Yield Summaries. Idaho Grain Magazine. Spring 2018. pp. 27-30.

MONTANA WERA-103 report

Submitted by Clain Jones, Montana State University

ONGOING RESEARCH

- Pulse crops – Drs. Jones, Miller, McPhee, and Bourgault obtained a USDA Pulse Crop Health Initiative grant to study effects of variety, inoculation and fertility on N fixation and residual nitrate levels in pea and lentil. Dr. Miller is investigating effects of K and S fertility on lentil yield and quality.
- Cropping Systems – Drs. Miller and Jones continue to investigate the effect of previous crop (legumes, brassicas, small grains) and crop rotation on N requirements and availability.

Deep P application - Dr. Bourgault is investigating the effects of deep P application on winter wheat. There are concerns that nutrient application in no-till systems has led to nutrient stratification with a high concentration at the surface for nutrients that are less mobile, such as phosphorus. Preliminary results show limited advantages of deep P application but surprisingly high yield benefits from just deep ripping.

- Cover crop cocktails – Dr. Miller, Dr. Jones, Dr. Zabinski, and M.S. student K. D’Agati are continuing to evaluate the effects of mixed cover crops on soil quality and nutrient availability, using herbicide termination. They have found that 6 species grew significantly more biomass than two species mixtures, but 8 species grew no more than 6 or 1 species. Soil quality differences have been few among treatments. The final soil sampling after four cycles will occur this spring. Dr. Boss and Dr. Bourgault are also studying mixed cover crops but using haying or grazing as additional termination strategies. Dr. McVay and Dr. Qhan have conducted trials at SARC on mixed cover crops since 2014 using a following crop of spring grain with different nitrogen fertilizer rates to determine the importance of various cover crop functional groups (e.g. legumes, grasses, taproot crops, and brassicas). Findings include mixed species cover crops can provide better assurance of successful establishment and biomass production than a single species cover crop. Overall there appears to be no competitive advantage (biomass yield) of mixtures compared to single species. Yield drag on a following grain crop ranges from 50 to 80% depending mostly on received moisture after the cover crop is terminated compared to chem fallow. After 2 cycles of cover crop/grain crop no differences in aggregate stability of soils sampled near the surface (0-5 cm) or infiltration rates could be attributed to inclusion of cover crops in the cropping system. Research continues into 2019.
- Nitrogen mineralization and overwinter nitrate changes – Drs. Carr, Eberly, and Jones are working with MS student S. Fordyce to determine effects of soil characteristics, temperature and moisture on N mineralization rates and overwinter nitrate changes.
- Cultivar specific response to Zn foliar application. Dr. Budak et al. studied spring wheat varietal differences to Zn fertilization on yield, plant height, test weight, kernel weight and grain Zn content, at three locations. Observed relative large variation in Zn concentration in the seed among the cultivars evaluated suggest that potential for the genetic improvement of seed Zn concentration in spring wheat in Montana exist; and that in the short term, foliar application of Zn prior to flowering might constitute a reliable strategy to enhance the productivity and end-use value of wheat produced in Montana.
- Soil acidification – Drs. Engel, Jones and Carr are investigating the extent of, and mitigation practices for, soil acidification in the Highwood Bench area in Chouteau County that are likely a result of nitrification from ammonium fertilizers. Soil pH levels (upper 7.5 cm) as low as 3.8 have been measured in dryland fields managed under a wheat-based cropping system. At some locations, yield increases were not observed with liming, but at one site, durum yields doubled with application of 11 Mg/ha of lime. Interestingly, at that same site, high rates of seed placed P also doubled durum yields. Field trials are also being conducted at two farms to identify among four crop species (spring wheat, barley, pea and canola) with cultivar susceptible and tolerant selections to low pH and Al toxicity. Soil pH decreases have found to be highly correlated with cumulative N rates (0.04 to 0.14 pH unit drops per 100 kg N/ha). Drone imagery by Dr. Powell has proved promising for identifying low pH areas within fields; this technology could help with variable rate application of N and lime.
- Sugarbeets. Dr. Chen continues to work on no-till sugarbeet nitrogen and irrigation requirements. He found that increasing N input rates resulted in decreased sucrose concentration and increased impurity values. Therefore, the extractable sugar did not significantly increase with increasing N rates, and nitrogen use efficiency greatly decreased with increasing N input. No-till sugarbeet can

produce similar yield and sucrose concentration compared to conventional tilled. However, the irrigation scheduling and N rates need to be optimized. Preliminary results showed that applying at most 168 kg N ha⁻¹ with 510 mm seasonal water use could achieve optimum yield and sucrose concentration.

- Site-specific nitrogen top-dress fertilizer management in winter wheat -Drs. Maxwell, Bekkerman, Sheppard and PhD students Paul Hegedus and Amy Peerlinck have created a computer application (software) that creates a GIS map of a fertilizer rate experiment from a field boundary map and stratifies plots locations based on previous year crop yield. The experiment map is made to be read by a variable rate fertilizer applicator. Grain yield monitor and protein analyzer data from the combine at harvest are then used to parameterize yield and protein prediction functions. The predicted crop response functions use a range of Google Earth Engine products and weather station data as well as nitrogen fertilizer rates to predict yield and protein. The response functions are then used in a simulation model with historic economic information to determine the probability that a profit maximizing site-specific application will produce higher economic net returns than a uniform application rate selected by the producer or the profit maximizing uniform rate. This site-specific experimentation approach on 5 farms and 18 fields since 2016 has resulted in determining that the profit maximizing site-specific variable rate approach has high probabilities of producing the highest net returns even when the technology costs are included.

PUBLICATIONS

JOURNAL PUBLICATIONS

- Chen, Chengci, Reza Keshavarz Afshar, Bart Stevens, Abdelaziz Nilahyane, Ronald Brown, William Iversen, and Timothy Fine. Finding the right combination – How beets react to nitrogen inputs under different tillage systems. *Sugar Producer*, January 2018.22-24.
- Jackson-Smith, D., S. Ewing, C. Jones, A. Sigler, and A. Armstrong. 2018. The road less traveled: Assessing the impacts of farmer and stakeholder participation in groundwater nitrate pollution research. *Journal of Soil and Water Conservation*. 73:610-622. doi: 10.2489/jswc.73.6.610
- Keshavarz Afshar, R., R. Lin, Y.A. Mohammed, **C. Chen**. 2018. Agronomic effects of urease and nitrification inhibitors on ammonia volatilization and nitrogen utilization in a dryland farming system: Field and laboratory investigation. *J. Cleaner Production*. 172:4130-4139. <http://dx.doi.org/10.1016/j.jclepro.2017.01.105>
- Miller, P.R., E.C. Glunk, J.A. Holmes, and R.E. Engel. 2018. Pea and barley hay as fallow replacement for dryland wheat. *Agron. J.* 110: 833-841.
- Sapkota, A., E. Meccage, R.N. Stougaard, J.P. Tanner, D.M Peterson, and J.A. Torrion (2018). Boron Fertilization of Irrigated Alfalfa in Montana. *Crop, Forage & Turfgrass Management*, 4(1). doi:10.2134/cftm2017.11.0085
- Sigler, W.A., S.A. Ewing, C.A. Jones, R.A. Payn, E.N.J. Brookshire, J.K. Klassen, D. Jackson-Smith, and G.S. Weissmann. 2018. Connections among soil, ground, and surface water chemistries characterize nitrogen loss from an agricultural landscape in the upper Missouri River basin. *Journal of Hydrology*. 556: 247-261. doi: 10.1016/j.jhydrol.2017.10.018
- Yang, R., C. Liang, J.A. Torrion, O.S. Walsh, K. O'Brien, and Q. Liu (2018). The Influence of Water and Nitrogen Availability on the Expression of End-Use Quality Parameters of Spring Wheat. *Agronomy*, 8(11), 257. <https://doi.org/10.3390/agronomy8110257>

EXTENSION PUBLICATIONS

- Jones, C., and K. Olson-Rutz. 2018. Minimizing Nitrate Leaching from Cropland. EB0226. MSU Extension. Bozeman, MT. 9 p.
- Miller, P., C. Jones, C. Zabinski, and J. Holmes. 2018. Mixed Cover Crop and Nitrogen Rate Effects on Wheat Yield and Protein after 6 Years. Fertilizer eFacts No. 76. MSU Extension, Bozeman, MT. 2 p.
- Mohammed, Y.A., and C. Chen. 2018. Micronutrient fertilizer application to increase pea yield and improve nutritional quality. Montana Fertilizer eFacts. No. 77, January 2018. MSU Extension, Montana Agricultural Experiment Station. Bozeman, MT. 2 p.

PROCEEDINGS, PRESENTATIONS, AND ABSTRACTS (* - presenter)

- Chen, C., A. Nilahyane, and R. Keshavarz Afshar. 2018. Nitrogen and water management of sugarbeet under no-till. 2018 ASA and CSSA Meeting. Baltimore, MD. November 04-07,
- Jones, C., P. Miller, A. Sigler, T. Rick and S. Ewing. 2018. Deep soil nitrate levels following four years of differing N rates and cropping systems. Great Plains Soil Fertility Conference. Denver, CO, March, 2018. 17:222-227.

New Mexico WERA-103 report

Submitted by Robert Flynn, New Mexico State University

CES College Dean and Chief Administrative Officer, Rolando Flores

Dr. John Boren, Associate Dean and Director, Cooperative Extension Service

Dr. Natalie Goldberg, Interim Associate Dean/Director, Agricultural Experiment Station Administration

Dr. Rolston St. Hilaire, Plant and Environmental Sciences Department Head & Extension Plant Sciences Interim Department Head

Dr. Gerald "Jerry" Sims, Entomology, Plant Science, and Weed Science Department Head

Extension Updates

Publications

New Mexico Peanut Production: Revised by Naveen Puppala, Natalie P. Goldberg, Leslie Beck, Soumaila Sanogo, Stephen Thomas, and Calvin Trostle.

Circular 586: Irrigated Pasture Management in New Mexico. Revised by L.M. Lauriault, M.A. Marsalis, and M.A. Ward

Guide M118: Monitoring Your Well Water. Rossana Sallenave, Kate Zeigler, and Amy Ganguli

Small Grain Forages for New Mexico. Circular 630. Mark Marsalis

Circular 690: Biochar for Arid and Semi-arid Agricultural Soils by John Idowu (Extension Agronomist, Dept. of Extension Plant Sciences) and Catherine E. Brewer (Assistant Professor, Dept. of Chemical Engineering).

Commercial Pumpkin Production for New Mexico. Guide H231 Revised by Stephanie Walker

Red Chile and Paprika Production in New Mexico, Revised by Stephanie J. Walker

Circular 660: Turfgrass Irrigation. Bernd Leinauer (Extension Turfgrass Specialist, Dept. of Extension Plant Sciences) and Dan Smeal (College Professor [retired], Agricultural Science Center at Farmington).

Guide H-320: Raspberries for the Home Garden. Shengrui Yao (Extension Fruit Specialist, Dept. of Extension Plant Sciences)

Guide H-325: Blackberry Production in New Mexico. Shengrui Yao.

Circular 687: Organic Matter in Farm and Garden Soils. Robert Flynn & John Idowu

Webcast. IPNI. Managing High Soil pH issues in the Western U.S. (<https://www.youtube.com/watch?v=hrxeoGxJZ1s>)

Research Update

Growth-Stage-Based Irrigation Management on Biomass, Yield, and Yield Attributes of Spring Canola in the Southern Great Plains. 2018. Krishna B. Katuwal, Sangamesh V. Angadi, Sukhbir Singh, Youngkoo Cho, Sultan Begna and M. R. Umesh. *Crop Science* 2018 110: 3: 939-949

Canopy Development of Annual Legumes and Forage Sorghum Intercrops and Its Relation to Dry Matter Accumulation. 2018. Murali K. Darapuneni, Sangamesh.V. Angadi, M. R. Umesh, Francisco E. Contreras-Govea, K. Annadurai, Sultan H. Begna, Mark A. Marsalis, N. A. Cole, Prasanna H. Gowda, G. Robert Hagevoort and Leonard M. Lauriault. *Agronomy Journal* 2018 110:3:939-949

Ganjegunte, Ulery, Niu, and Wu. 2018. Organic Carbon, Nutrient and Salt Dynamics in Saline Soil and Switchgrass Irrigated with Treated Municipal Wastewater. *Land Degradation & Development*. 29(1):80-90.

Begna S., S. Angadi, M. Stamm, and A. Mesbah. 2017. Winter canola: a potential dual-purpose crop for the United States southern Great Plains. *Agronomy Journal* 109:2508-2520.
doi:10.2134/agronj2017.02.0093

Dissertations

Singh, Lovepreet. Improving Biomass Productivity of Alfalfa (*Medicago Sativa* L.) Under Water Limited Environments. 2018.

Gioannini, Rachel. Plant Communities Suitable for Green Roofs in Arid Regions. 12/9/2017.

Other

Composting Program: Dr. Flynn continues to work with students interested in composting and methods of improving soil properties in an irrigated environment. Current student is comparing Mid-West Bio methodologies to traditional practices. Composts are made from pecan tree trimmings and local dairy manure. An economic component is included with the study.

Westernsoils.nmsu.edu is still active and receiving hits. We had a contact from MIT email a question and was happy to have used the website. These types of statements speak well of the collaborative nature of our WERA 103 collaborations.

Dr. Flynn is evaluating plant response to salinity for biofuel and ethanol production along with traditional crops such as cotton with colleagues from Texas A&M and NMSU. He also assisted students working on guar production across irrigation treatments as well as varietal differences. He will collaborate with Dr. Idowu over the next summer to determine any benefits to potassium fertilization in specific clay soils of the Rio Grande.

OREGON WERA-103 report

Submitted by Dan Sullivan, Oregon State University

Ongoing research

Berry crops

David Bryla (USDA-ARS, Horticultural Crops Research Unit, Corvallis, OR) continues to conduct research on water and nutrient management of berry crops. He and his team are currently using unmanned aerial vehicles (drones) to monitor plant water status and estimate the seasonal water requirements in blueberry and raspberry. They are also building on their previous work on fertigation with liquid N fertilizers in blueberry and are now in the process of evaluating whether fertigation with K, P, and B fertilizers is more effective than traditional methods of applying these nutrients. The K fertilizers tested included water-soluble K sulfate and fluid K thiosulfate, as well as three K products with organic acids. Each product was safe and improved soil and plant nutrition, but none of them had any effect on fruit production after two years of use in our plantings in Oregon. Application of fertilizers containing organic acids resulted in retention of more available K in the soil than with K sulfate, suggesting they could be useful at sites with K deficiency. The work on P and B are limited to a year of data at this point but strongly suggest that fertigation with B is more effective than using a single spring application of granular B and more reliable than foliar applications of the fertilizer. Publications are available at <https://www.ars.usda.gov/pacific-west-area/corvallis-or/horticultural-crops-research/people/david-bryla/>.

Bernadine Strik continues to research nutrient management in blueberry, particularly in organic production systems. An on-going project is focused on the impact of soil and plant nutrient status on yield as affected by long-term fertilization with high-potassium containing fertilizer sources (fish emulsion and yard-debris compost). Strik and colleagues have found that various sources of fertilizer were effective when fertilizing ten blueberry cultivars in an organic system, but pre-plant amendment with an on-farm compost increased soil pH so much so that some cultivars had reduced yield. Strik and colleagues are now assessing the impact of green or black weed mat with or without sawdust underneath on blueberry plant growth and nutrient uptake as compared to sawdust mulch alone. Publications are available at <https://agsci.oregonstate.edu/users/bernadine-strik>

Agronomic crops

R. Qin. (Hermiston) Project: Nitrogen and plant growth regulator (PGR) for bluegrass and wheat.

Description: Field trials are being conducted to evaluate the effect of trinexapac-ethyl (TE) plant growth regulators on the growth and seed production of Kentucky Bluegrass and the interaction of N fertilization with PGR.

A. Moore (statewide). New projects include:

- Re-evaluation of SMP buffer for lime requirement estimates in the Willamette Valley
- Evaluating soil health response to alternative fumigants in potato production systems.
- Nutrient uptake and N cycling in hybrid carrots produced for seed
- Sulfur mineralization potential of various biosolids types

Vegetable crops

R.E. Peachey and D.M. Sullivan (Willamette Valley). Project: Interseeded cover crops. Description: Interseeding, the drilling of winter cover crops directly into growing summer vegetable crops at midseason has been under evaluation for several years. Demonstration plots have been placed in approximately 25 producer fields over 3 years to test grower strategies. Interseeded cereal cover crops produced more biomass and were more uniform than broadcast cover crops. Interseeding at V6 in sweet corn was optimum for cover crop establishment and avoiding competition with corn crop.

R.E. Peachey and D.M. Sullivan (Willamette Valley). Project: Nitrogen management for broccoli. Description: This project is evaluating N rate, timing (all preplant vs. split application), and source (urea vs. feather meal) for production of processed broccoli. 2018 was the first year of a two-year project. In, 2018, maximum head yield was attained with application of 120 lb N/acre (preplant or split application) as feather meal or urea.

Publications

Journal

Araujo, E., Strawn, D., Morra, M., Moore, A. D., Ferracciu Alleoni, L. (2019). Association between extracted copper and dissolved organic matter in dairy-manure amended soils. *Environmental Pollution*, 246, 1020-1026. <https://doi.org/10.1016/j.envpol.2018.12.070>

Awale, R., Machado, S., & Rhinhart, K. E. L. (2018). Soil Carbon, Nitrogen, pH, and Crop Yields in Winter Wheat-Spring Pea Systems, 110(4), 1523–1531. <https://doi.org/10.2134/agronj2017.07.0371>

Downing, T. W. (2018). Documenting grass growth and productivity in a grass-based organic dairy in Oregon, 34, 144–147. *The Professional Animal Scientist*. Volume 34, Issue 2, April 2018, Pages 144-147

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Moore, A. D., Pirelli, G. J., Filley, S. J., Fransen, S., Sullivan, D. M., Fery, M. A., & Thompson, T. M. (2019). *Nutrient Management for Pastures: Western Oregon and Western Washington* (EM 9224, p. 16). Corvallis, OR, Benton: OSU Extension and Experiment Station Communications <https://catalog.extension.oregonstate.edu/em9224>

Moore, A. D., Wysocki, D. J., Chastain, T. G., Wilson, T., Duval, A. S. (2019). *Nutrient management guide: Camelina* (PNW 718, pp. 5). Oregon State University Extension and Experiment Station Communications. <https://catalog.extension.oregonstate.edu/pnw718>

Sullivan, D. M., Andrews, N., Heinrich, A. L., Peachey, R. E., Brewer, L. J. (2019). Soil nitrate testing for Willamette Valley vegetable production (vol. EM9221, pp. 19). Corvallis OR: Oregon State University Extension Service.. <https://catalog.extension.oregonstate.edu/em9221>

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Awale, R., Machado, S., & Rhinhart, K. E. L. (2018). Soil Carbon, Nitrogen, pH, and Crop Yields in Winter Wheat-Spring Pea Systems, 110(4), 1523–1531. <https://doi.org/10.2134/agronj2017.07.0371>

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Moore, A. D., Chastain, T. G., Wysocki, D. J., Wilson, T., & Duval, A. S. (2018). Camelina: A Nutrient Management Guide for Oregon, Washington, and Idaho., (Poster #1004). <https://scisoc.confex.com/scisoc/2018am/meetingapp.cgi/Paper/111570>

Moore, A. D., Rogers, C., Leytem, A., Marshall, J., Agronomy Society of America Meeting, "Wheat Grain Yield, Grain Protein, and Bread Quality Response to Repeated Dairy Manure Applications." Baltimore, MD.

Parke, J. L., Mallory-Smith, C. A., Dragila, M. I., Hill, B., Wada, N., Weidman, C. Buckland, K. (2018). Soil solarization – a potential tool for organic growers to manage weeds and improve soil health, p.12–18. In; *Organic Farmer* <https://www.yumpu.com/en/document/fullscreen/62280511/organic-farmer-dec-jan-2019>

Qin, R., Anderson, N. P., Walenta, D. L., Lukas, S. B., 2018 ASA-CSSA-SSSA International Annual Meeting, "Effects of Trinexapac-ethyl Plant Growth Regulator and Nitrogen on Kentucky Bluegrass Seed Production in the Columbia Basin," Baltimore, Maryland.

UTAH WERA-103 report

Utah Annual Report - Utah State University (Grant Cardon and Matt Yost) and Brigham Young University (Bryan Hopkins)

Major accomplishments for Utah State University include the following two research areas:

1) Nitrogen fertility management in rotational crops following alfalfa, and phosphorus management for dryland grain.

For the irrigated alfalfa and rotational crop project (***Grant and grad student Bailey Shaffer***) the research culminated in a proposed revision of long-standing fertilizer recommendations for rotational corn silage (the primary rotational crop in the state). After 37 site years over five growing seasons in eight different counties across Utah, only 3 sites showed response to applied nitrogen following alfalfa in both the first and second years of rotation. Sites that were significantly responsive only showed small increases (3 to 4 tons per acre) in yield and were generally found on fields where leaching from excess irrigation occurred.

It is clearly possible to reduce the N requirement for first year corn after alfalfa up to 200 units of N per acre without yield reduction. The current recommendation of an N credit of 100 units of N per acre will also be extended to second year corn, where that has not been part of state recommendations in the past. This adjustment to the recommendations is projected to save Utah corn growers up to \$6-\$12

million for first year rotational corn and half that for second year rotational corn (depending on the percentage of alfalfa acreage in rotation).

in 2018, harvest of 18 irrigated small grain sites in first and second year rotation following alfalfa was also completed (**Grant, Matt and graduate student Collin Pound**).

This project was established as follow up to the research on rotational corn silage completed in 2018. Small grains are the second most common rotational crops with alfalfa, and we will be testing the need to adjust nitrogen credit recommendations for these crops in coming years.

For the dryland grain fertilizer management project (**Grant and graduate student Ryan Hodges**) it was shown that large applications of soluble phosphorus fertilizers promote lower P-related yield response on highly calcareous, heavily eroded soils, presumably due to increased release of soil calcium which precipitates with P rendering it less soluble, hence less available to the crop.

Lower rates of P, particularly used in conjunction with Avail technology designed to keep fertilizer P from precipitation reactions, performed just as well, if not better, than full rates of P application. This, again, is of significant importance to Utah dryland grain growers in that it presents potential input cost savings.

2) Variable Rate irrigation and fertility management of orchard crops.

The maps of orchard canopy structure and density using canopy light interception, was successfully coupled with maps of soil properties variation and drone imagery to develop irrigation and fertility management zones to account for differential need of water and fertilizer (**Grant, Matt Yost and graduate student Cole Harding**)

Management zones based on these maps were developed for five tart cherry orchards and variable rate irrigation and fertility trials were deployed for the 2019 growing season.

Dissemination

Five scientific poster presentations and two oral presentations were made in 2018 covering results from the four graduate student projects previously noted in the accomplishments section above. Two MS theses have also been completed and are in the process of final filing in USU Digital Commons. Moreover, a detailed Extension Research Bulletin is currently in review that summarizes the nitrogen needs of rotational corn silage following alfalfa as the foundational basis of the changes in the nitrogen recommendation we have proposed. Plans are to have at least one refereed research paper from each graduate student project in review in 2019.

Plan for 2019

Work will continue on the potential for crediting nitrogen for a previous alfalfa crop to subsequent rotational crops (other than silage corn as previously studied from 2014-2018), extending the research into small grains. In addition to the 18 site years of data collected over the last two growing seasons (2017 and 2018), we have established 15 sites in 2019 with hope of adding four or five more in the spring of 2019.

Funding was obtained with cooperation from orchard growers in Utah County and through the efforts of a new Assistant Professor, **Matt Yost**, in the department, to use our mapped canopy light interception and correlated soil physical and chemical conditions, and drone imagery, to establish variable rate irrigation and fertilizer management zones to test the potential for such zonal management in these high value fruit crops.

Accomplishment for Brigham Young University

Refereed Journal Publications - In Press:

Hopkins, B.G., K.J. Fernelius, N.C. Hansen, and D. L. Eggett. 2018. A response to the letter to the editor from Chien et al. (Comments on "AVAIL phosphorus fertilizer enhancer: Meta-analysis of 503 field evaluations" by B.G. Hopkins et al.) *Agron. J.* 110(4):1627-1630. DOI: 10.2134/agronj2018.03.0161

Hopkins, B.G., K.J. Fernelius, N.C. Hansen, and D.L. Eggett. 2018. AVAIL phosphorus fertilizer enhancer: Meta-analysis of 503 field evaluations. *Agron. J.* 110: 389-398.

LeMonte, J.J., V.D. Jolley, T.M. Story, and B.G. Hopkins. 2018. Assessing atmospheric nitrogen losses with photoacoustic infrared spectroscopy: Polymer coated urea. *PLOS ONE.* 13(9): e0204090. DOI:org/10.1371/journal.pone.0204090

Professional Meetings with Abstracts:

Cole, D.L., A. Tyler, A. Lambert, S.V. Nelson, T. Billin and B.G. Hopkins. 2018. A new hydroponic system for testing mineral nutrient deficiencies in plants. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency fertilizers in turfgrass: A review. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency nitrogen fertilizers: Review. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency phosphorus fertilizers: Review. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, A.P., N.C. Hansen, B.G. Hopkins, and C.S. Campbell. 2018. Remote Sensing Approaches to Improve Water and Nitrogen Management of Kentucky Bluegrass. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Parkinson, M.E., M.D. Madsen, and B.G. Hopkins. 2018. Use of phosphorus fertilizer as a seed coating enhance seedling growth of bluebunch wheatgrass. . In Abstracts, *Proc. of the 71st Society for Range Management (SRM) Annual Meeting*; 28 Jan.- 2 Feb. 2018; Sparks, NV. Littleton, CO: Society for Range Management.

Valencia, M.C., S.V. Nelson, R. Lawrence, N.C. Hansen, M.D. Madsen, V. Anderson, S.L. Petersen and B.G. Hopkins. 2018. Phosphorus fertilizer and hydrogel for rangeland seedling success. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Weigel, A.M., B.G. Hopkins, and T.G. Searle. 2018. Granulated homogenous potassium and boron fertilizer: Impact on alfalfa quality and yield. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA- ASA•CSSA.

Wilcox, M., C. Hollist, B.G. Hopkins, T.G. Searle, and J.D. Williams. 2018. Granulated homogeneous micronutrient fertilizers: Impact on potato yield and quality. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Wilcox, M., T. Rawlins, T.G. Searle, B.G. Hopkins, and J.D. Williams. 2018. Polymer coated and uncoated urea blends: Impact on Russet Burbank potato yield and quality. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Wilcox, M., B.G. Hopkins, T.G. Searle and J.D. Williams. 2018. Polymer coated urea impact on barley yield, flag leaf nitrogen, and protein. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Zeyer, S.M., J.D. Svedin, C.H. Porter, D.C. Cole, T.J. Hopkins and B.G. Hopkins. 2018. Struvite as an enhanced efficiency phosphorus fertilizer for sugarbeet and potato. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Trade Journals/Popular Press:

Hopkins, B.G. and N.C. Hansen. 2018. University turf researchers are working for you: Brigham Young University research update. *SportsTurf*. 34(6): 27-29. Available at: <http://read.epgmediallc.com/i/987581-june-2018>

Hopkins, B.G. and T.J. Hopkins. 2018. Carbon: the next frontier in fertilization? *Crops & Soils*. 51 (3) 36-38. Available at: <https://dl.sciencesocieties.org/publications/cns/articles/51/3/36>.

Webcasts and Digital Education (Invited):

Hopkins, B.G. 2018. Enhanced efficiency nitrogen and phosphorus fertilizers. *Western Region Nutrient Management Coordinating Committee*; 19 July 2018.
Presentations at Professional Meetings

Crosland, M., B. Peacock, B. Geary, and B.G. Hopkins. 2018. Nitrogen and *Rhizoctonia solani* interactions in creeping bentgrass (*Agrostis stolonifera* L.). *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Douglas, C., and B.G. Hopkins. 2018. Enhanced efficiency fertilizers in sports turf. *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Hastriter A., K. Russell, and B.G. Hopkins. 2018. Nitrogen and water interactions in Kentucky bluegrass (*Poa pratensis* L.). *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Hopkins, B.G. 2018. Nitrogen management innovations. *Shoshone Bannock Tribe Grower's Meeting*; 16 March 2018; Fort Hall, ID.

Hopkins, B.G. 2018. Potato rotations and soil fertility/plant nutrition. *Lamb Weston meeting*; 22 Feb. 2018; Twin Falls, ID

Hopkins, B.G., 2018. Advanced soil science for the sports turf Professional. *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Pedigo, A., J. Svedin, and B.G. Hopkins. 2018. Polymer coated urea in Kentucky bluegrass (*Poa pratensis* L.). *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Bryan Hopkins (BYU)

Refereed Journal Publications - In Press:

Hopkins, B.G., K.J. Fernelius, N.C. Hansen, and D. L. Eggett. 2018. A response to the letter to the editor from Chien et al. (Comments on "AVAIL phosphorus fertilizer enhancer: Meta-analysis of 503 field evaluations" by B.G. Hopkins et al.) *Agron. J.* 110(4):1627-1630. DOI: 10.2134/agronj2018.03.0161

Hopkins, B.G., K.J. Fernelius, N.C. Hansen, and D.L. Eggett. 2018. AVAIL phosphorus fertilizer enhancer: Meta-analysis of 503 field evaluations. *Agron. J.* 110: 389-398.

LeMonte, J.J., V.D. Jolley, T.M. Story, and B.G. Hopkins. 2018. Assessing atmospheric nitrogen losses with photoacoustic infrared spectroscopy: Polymer coated urea. *PLOS ONE*. 13(9): e0204090. DOI:org/10.1371/journal.pone.0204090

Professional Meetings with Abstracts:

Cole, D.L., A. Tyler, A. Lambert, S.V. Nelson, T. Billin and B.G. Hopkins. 2018. A new hydroponic system for testing mineral nutrient deficiencies in plants. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency fertilizers in turfgrass: A review. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency nitrogen fertilizers: Review. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency phosphorus fertilizers: Review. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

- Hopkins, A.P., N.C. Hansen, B.G. Hopkins, and C.S. Campbell. 2018. Remote Sensing Approaches to Improve Water and Nitrogen Management of Kentucky Bluegrass. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.
- Parkinson, M.E., M.D. Madsen, and B.G. Hopkins. 2018. Use of phosphorus fertilizer as a seed coating enhance seedling growth of bluebunch wheatgrass. . In Abstracts, *Proc. of the 71st Society for Range Management (SRM) Annual Meeting*; 28 Jan.- 2 Feb. 2018; Sparks, NV. Littleton, CO: Society for Range Management.
- Valencia, M.C., S.V. Nelson, R. Lawrence, N.C. Hansen, M.D. Madsen, V. Anderson, S.L. Petersen and B.G. Hopkins. 2018. Phosphorus fertilizer and hydrogel for rangeland seedling success. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.
- Weigel, A.M., B.G. Hopkins, and T.G. Searle. 2018. Granulated homogenous potassium and boron fertilizer: Impact on alfalfa quality and yield. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA- ASA•CSSA.
- Wilcox, M., C. Hollist, B.G. Hopkins, T.G. Searle, and J.D. Williams. 2018. Granulated homogeneous micronutrient fertilizers: Impact on potato yield and quality. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.
- Wilcox, M., T. Rawlins, T.G. Searle, B.G. Hopkins, and J.D. Williams. 2018. Polymer coated and uncoated urea blends: Impact on Russet Burbank potato yield and quality. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.
- Wilcox, M., B.G. Hopkins, T.G. Searle and J.D. Williams. 2018. Polymer coated urea impact on barley yield, flag leaf nitrogen, and protein. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.
- Zeyer, S.M., J.D. Svedin, C.H. Porter, D.C. Cole, T.J. Hopkins and B.G. Hopkins. 2018. Struvite as an enhanced efficiency phosphorus fertilizer for sugarbeet and potato. In Abstracts, ASA•CSSA International Annu. Meet.; 4-7 Nov 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Trade Journals/Popular Press:

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- Hopkins, B.G. and T.J. Hopkins. 2018. Carbon: the next frontier in fertilization? *Crops & Soils*. 51 (3) 36-38. Available at: <https://dl.sciencesocieties.org/publications/cns/articles/51/3/36>.

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- Hopkins, B.G. 2018. Enhanced efficiency nitrogen and phosphorus fertilizers. *Western Region Nutrient Management Coordinating Committee*; 19 July 2018.

Presentations at Professional Meetings

- Crosland, M., B. Peacock, B. Geary, and B.G. Hopkins. 2018. Nitrogen and *Rhizoctonia solani* interactions in creeping bentgrass (*Agrostis stolonifera* L.). *Sports Turf Managers Association*

(STMA) Annu. Meet; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Douglas, C., and B.G. Hopkins. 2018. Enhanced efficiency fertilizers in sports turf. *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Hastriter A., K. Russell, and B.G. Hopkins. 2018. Nitrogen and water interactions in Kentucky bluegrass (*Poa pratensis* L.). *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Hopkins, B.G. 2018. Nitrogen management innovations. *Shoshone Bannock Tribe Grower's Meeting*; 16 March 2018; Fort Hall, ID.

Hopkins, B.G. 2018. Potato rotations and soil fertility/plant nutrition. *Lamb Weston meeting*; 22 Feb. 2018; Twin Falls, ID

Hopkins, B.G., 2018. Advanced soil science for the sports turf Professional. *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

Pedigo, A., J. Svedin, and B.G. Hopkins. 2018. Polymer coated urea in Kentucky bluegrass (*Poa pratensis* L.). *Sports Turf Managers Association (STMA) Annu. Meet*; 16-19 Jan. 2018; Fort Worth, TX. Lawrence, KS: Sports Turf Managers Association.

WASHINGTON WERA-103 report

Haiying Tao, Washington State University

Peer-reviewed publications

Tao*, H., T.F. Morris, P. Kyveryga, J. McGuire. 2018. Factors affecting nitrogen availability and variability in cornfields. *Agron. J.* 110:1974-1986.

Tao*, H., W.L. Pan, P. Carter, K. Wang. 2019. Addition of lignin to lime materials for expedited pH increase and improved vertical mobility of lime in no-till soils. *Soil Use and Management*. Accepted.

Peer-reviewed Extension publications

Tao, H., W.L. Pan, P. Carter, K. Wang. A wheat straw pulping co-product mixed with lime may address soil acidification in the PNW. WSU Extension Factsheet. Washington State University, Pullman, WA. Accepted with revision.

Tao, H. and C.W. Rogers. Nitrogen inhibitors: how do they work to reduce N losses? A general introduction. WSU Extension Factsheet. Washington State University, Pullman, WA. Accepted with revision.

Tao, H., G. Yorgey, D. Huggins, D. Wysocki. 2017. Crop residue management. Pages 125-162. In G. Yorgey and C. Kruger (eds). *Advances in Sustainable Dryland Farming in the Inland Pacific Northwest*. WSU Extension Bulletin EM108. Washington State University, Pullman, WA.

Borrelli, K., W.L., Pan, **H. Tao**, C. Paul, T. Maaz. 2017. Soil Fertility Management, Pages 237-283. In G. Yorgey and C. Kruger (eds). *Advances in Sustainable Dryland Farming in the Inland Pacific Northwest*. WSU Extension Bulletin EM108. Washington State University, Pullman, WA.

Magazine publications

Tao, H. 2019. Factors affecting nitrogen availability and variability in cornfields. *Crop & Soil magazine*. 52(1):4-9. Soil Science Society of America, Crop Science Society of America, American Society of Agronomy. Online ISSN: 2325-3606, Print ISSN: 0162-5098. Madison, WI.

Tao, H. 2019. Soil health assessment: what is it good for? *Wheat Life*. Ritzville, WA.

Tao, H. 2018. Changing roles: from learner to thinker. *CSA News Magazine*. 63(7):32-34. Soil Science Society of America, Crop Science Society of America, American Society of Agronomy. Online ISSN: 2325-3584, Print ISSN: 1529-9163. Madison, WI.

Tao, H. 2017. Reducing nitrogen loss-enhanced-efficiency fertilizer products may be the answer. *Wheat Life*. Ritzville, WA.

Workshop Hosted & Extension Platform Created

Tao, H. WSU Farmers Network.

Tao, H. And Carol McFarland. Jan. 22, 2019. Management Matters for Soil Health. Pullman, WA. One-day workshop. 85 participants from universities, conservation districts, USDA-ARS, USDA-NRCS, industries, farms in the WA, ID, OR.

Tao, H. Mar. 19-21, 2018. Digital Farming Workshop. Pullman, WA. Three-day workshop teaching decision-making using digital technologies. 18 participants from universities and industry agronomists.

Tao, H. And Carol McFarland. Feb. 8, 2018. Managing for Healthy Soils-The Foundation of Healthy Farms Workshop. Pullman, WA. One-day workshop. 86 participants from universities, conservation districts, USDA-ARS, USDA-NRCS, industries, soil testing labs, farm organizations, high school, farms in the WA, ID, OR, MT.

Tao, H. and Carol McFarland. Jan. 4, 2018. Soil Acidity on the Palouse-Digging Deeper Workshop. Pullman, WA. One-day workshop. 150 participants from universities, conservation districts, USDA-ARS, USDA-NRCS, industries, farms in the WA, ID, OR.

Bullock, D., **H. Tao**, B. Maxwell. Dec. 15-18, 2017. A Workshop to Plan an International Cyber-infrastructure for On-farm Production Research. LA, CA. 50 Participants.

Abstracts and Presentations

Breslauer*, R.S., **H. Tao**, D.R. Huggins, and W.L. Pan. 2019. Do restrictive soils impact nitrogen needs in dryland wheat systems? SSSA International Annual Meeting. San Diego, CA.

Breslauer*, R.S., **H. Tao**, D. Brown, and W.L. Pan. How does reduced rooting depth in wheat impact use of stored soil water? SSSA International Annual Meeting. San Diego, CA.

Tao, H., K. Naasko, I. Madsen, and W.L. Pan. 2019. Soil health indicators for dryland production systems in the inland Pacific Northwest. SSSA International Annual Meeting. San Diego, CA.

Porter*, M., **H. Tao**, and I. Madsen. 2019. Winter canola nutrient uptake in the inland Pacific Northwest. SSSA International Annual Meeting. San Diego, CA.

Naasko*, K., I. Madsen, **H. Tao**, W.L. Pan, and D.R. Huggins. 2019. Dynamic topsoil properties of the inland Pacific Northwest. SSSA International Annual Meeting. San Diego, CA.

Naasko*, K., I. Madsen, **H. Tao**, W.L. Pan, and D.R. Huggins. 2019. Dynamic topsoil properties of the inland Pacific Northwest. Poster. SSSA International Annual Meeting. San Diego, CA.

Manuel*, J., K. Naasko, I. Madsen, W.L. Pan, and **H. Tao**. 2019. Landscape and management effect on water infiltration as measured by the Cornell and single ring infiltration methods. SSSA International Annual Meeting. San Diego, CA.

Wills, S., M. Robotham, J. Nemecek, D. Osmond, J. Heitman, D. Presley, P. Tomlinson, **H. Tao**, P. DeLaune, K. Lewis, G. Liles, F. Arriaga, and L. Adams. 2019. Putting soil health indicators in context: a project using dynamic soil properties and soil survey to provide references and potentials. SSSA International Annual Meeting. San Diego, CA.

Porter*, M., **H. Tao**, I. Madsen. 2018. Influence of nitrogen application rate and timing on yield and quality of winter canola. ASA & CSSA International Annual Meeting. Baltimore, MD. Poster.

Delwiche, S.R., S. Rausch., **H. Tao**. 2018. Wheat falling number as affected by field topography. AACC International Cereals & Grains Association Annual Meeting, London, UK.

Fitria*, H. Ruan, S.C. Fransen, A.H. Carter, **H. Tao**, B. Yang. 2018. Selecting winter wheat for cellulosic ethanol production in the Pacific Northwest. Symposium of Biotechnology for Fuels and Chemicals. Clearwater Beach, FL.

Michel*, L., L. Carpenter-Boggs, N. Embertson, T. Sullivan, **H. Tao**. 2018. Establishing cover crops for soil health in low-rainfall eastern Washington. Pacific Northwest Direct Seed Association. 2018 Cropping Systems Conference. Kennewick, WA. Poster.

Porter*, M., **H. Tao**, W.L. Pan, K. Sowers, and D. Roe. 2017. Improving nitrogen use efficiency for winter canola using 4R stewardship. ASA, CSSA, & SSSA International Annual Meetings. Tampa, FL. Poster.

Breslauer*, R., **H. Tao**, D. Brown, and W.L. Pan. 2017. Impact of slope direction on winter wheat protein content in the Inland Northwest. ASA, CSSA, & SSSA International Annual Meetings. Tampa, FL. Poster.

Breslauer*, R., **H. Tao**, D. Brown, and W.L. Pan. 2017. A hard place to farm: the impact of hydraulically restrictive layers on nitrogen use efficiency. ASA, CSSA, & SSSA International Annual Meetings. Tampa, FL.

Lyon, D. and **H. Tao**. 2017. Teaming up for success: the wsu extension dryland cropping systems team. ASA, CSSA, & SSSA International Annual Meetings. Tampa, FL. Poster.

Invited Presentations

Porter, M., I. Madsen, **and H. Tao**. Nutrient management of canola. 2019 Washington Oilseed Cropping Systems Workshop. Clarkston. ~150 people.

Porter, M., I. Madsen, **and H. Tao**. Nutrient management of canola. 2019 Washington Oilseed Cropping Systems Workshop. Wilbur. ~100 people.

Tao, H. 2019. Soil organic matter: small component, big impact. G.S. Long Winter Ag Academy Meets. Kennewick, WA. ~150 people.

Tao, H. and R. Koenig. 2018. Chloride fertility in wheat. Far West Agrobusiness Association December Winter Conference. Kennewick, WA. 50 minutes presentation, ~60 people.

Pan, W.L. and **H. Tao**. 2018. A wheat straw pulping co-product mixed with lime may address acidified soil acidification in the PNW. Far West Agrobusiness Association December Winter Conference. Kennewick, WA. 50 minutes presentation, ~50 people.

Rogers, C.W. and **H. Tao**. 2018. Understanding the effectiveness of nitrogen inhibitors-two case studies. Far West Agrobusiness Association December Winter Conference. Kennewick, WA. 50 minutes presentation, ~60 people.

Tao, H. 2018. Protein and nutrient management in cereal grains. WSU Wilke Research & Extension Farm Field Day. Davenport, WA, ~100 people.

Tao, H. 2018. Management strategies to alleviate the acceleration of soil acidification. McGregor Company Training Program. Colfax, WA. 50 minutes presentation, ~40 people.

Tao, H. 2018. Nitrogen fertility of winter canola. WSU Oilseed Workshops. Colfax & Richland, WA. Joint 50-minute presentations, ~200 people.

Tao, H. 2018. Management strategies to alleviate the acceleration of soil acidification. Soil Acidity on the Palouse-Digging Deeper Workshop. Pullman, WA. 50 minutes presentation, ~150 people.

Tao, H. 2017. Large-scale On-farm research trials to support soil fertility. A Workshop to Plan an International Cyber-Infrastructure for On-farm Production Research. LA, CA. 50 people.

Tao, H and Aaron Esser. 2017. Large-scale on-farm research trials to support soil fertility management. Wheat Academy, WA. 50 minutes presentation, 75 people.

Tao, H. 2017. Grazing early planted winter canola. WSU Oilseed Workshops. Hartline, Colfax, Odessa, WA. Joint 50-minute presentations, ~150 people.

Tao, H. 2017. Nitrogen rate & timing in winter canola. WSU Irrigated Winter Canola Twilight Tour & BBQ. Field Day in Odessa, WA, ~30 people.

Tao, H. 2017. Nitrogen rate & timing in winter canola. WSU Winter Canola Tour. Field Day in Ralston, WA, ~30 people.

Tao, H. 2017. Nitrogen rate & timing in winter canola. WSU Winter Canola Tour. Field Day in St. John, WA, ~30 people.

Tao, H. 2017. Nitrogen inhibitors and stabilizers for improved nitrogen use efficiency. Latah Soil & Water Conservation District Board Meeting. Moscow, ID. 50 minutes presentation, ~20 people.

Tao, H. 2017. Organic fertilizer sources and mineralization: helping planners better estimate mineralization. Nutrient Management Planning Training-Virtual Day. Whatcom Conservation District. ~20 people.

Tao, H., D. Granatstein, J. Davenport, T. Dupont. 2017. Soil health in perennial and annual cropping systems-Central WA Soils. Washington Soil Health Meeting. Ellensburg, WA. ~30 people.

Tao, H. 2017. Protein monitors as a tool to assess soils. Wilke Soil Health Workshop. Ritzville, WA. ~50 people.

Current Projects Funded (Tao as PI or Co-PI)

Nutrient management for winter canola. Washington Oilseeds Commission. (01/2019-12/2019).

Ameliorating soil acidity using by-product of energy production. Avista Corporation.

Technology for converting excess nitrogen in dairy manure to fertilizer. Applied BioEnergy Research Program, WSU.

Crop yield and soil health response to P fertilization. Harley Jacquot Soil Fertility Endowment Fund.

Technology for converting excess nitrogen in dairy manure to fertilizer. Applied BioEnergy Research Program, WSU.

Impact of Biochar, Black Liquor, and Fly Ash Application to Soil on Productivity of Wheat in Eastern Washington. WSU BioAg. T.D. Murray (PI),

Soil health assessment for PNW cropping systems. USDA-NRCS.

Sustainable Crop-Livestock Integration for System Health in the Dryland Inland Pacific Northwest. WSU BIOAg.

A workshop to plan an international cyber-infrastructure for on-farm precision experiments research. USDA-NIFA-FACT

Concentrating and Blending of Manure Nutrients to Enhance Sustainable Production. WSDA-Specialty Crop Block Grant Program.

Fertility management for winter canola and spring canola. WA Oilseed Cropping Systems Competitive Grant Program.

Developing variable rate nitrogen application maps for dryland wheat production in Washington. Amen Dryland Research Endowment.

Integrating livestock to dryland system-grazing on dual-purpose winter canola. WA Oilseed Cropping Systems Competitive Grant Program.

Sustainable Crop-Livestock Integration for the System Health in the Dryland Inland Pacific Northwest. Western SARE.

Post-harvest evaluation for reducing N rate, improving soft white winter wheat yield and quality. WSU New Faculty Seed Grant Competition.

WYOMING WERA-103 report

Jay Norton and Urszula Norton, University of Wyoming

Compost and cover crop options in dryland grain systems, Norton, J .B, and U. Norton . Funded by USDA Organic Research & Extension Initiative through a subaward from Utah State University, and the Wyoming Department of Agriculture. Objectives: 1. Evaluate long-term effects of one-time, high-rate compost application in a winter-wheat-fallow system; 2. Evaluate efficacy of cover crops; and 3. Evaluate synergistic effects of combined cover crops and compost applications. Contact: jnorton4@uwyo.edu; unorton@uwyo.edu.

Grazing impacts on soils of herbaceous riparian wetlands in the National Historic Trails Corridor, Norton, J.B. Funded by the Bureau of Land Management. Objectives: 1. Determine soil carbon, soil temperature, and water storage effects of long-term grazing exclosures in an area subjected to uncontrolled grazing for over 100 years; 2. Evaluate effects of riparian grazing management systems implemented within the last 10 years; 3. Extrapolate in space and time using remote sensing and GIS techniques. Contact: jnorton4@uwyo.edu.

Integrating cover crops and livestock in irrigated cropping systems, Norton, J.B, U. Norton, J. Ritten, C. Jones. Funded by Western SARE and the Northern Plains Climate Hub. Objectives: 1. Evaluate soil health, forage quality, and economic factors of planting cover crops following malting barley harvest in sugarbeet-barley rotations; 2. Compare use of barley as a cover crop with a multi-species mixture; 3. Assess soil health/economic tradeoffs of grazing or haying cover crops. Contact: jnorton4@uwyo.edu.

Dry beans as part of sustainable cropping systems, Norton, J.B., U. Norton and J. Heitholt. Funded by the Wyoming Bean Commission and a Specialty Crops grant from Wyoming Dept of Ag. Objective: Evaluate yield, harvest losses, nitrogen fixation, and water use efficiency of four varieties of dry beans in sugarbeet-bean-barley rotations under conventional and minimum till systems, and full and limited irrigation. Contact: jnorton4@uwyo.edu.

Publications

Ghimire, R., J.B. Norton, and U. Norton. 2018. Soil organic matter dynamics under irrigated perennial forage – annual crop rotations. *Grass and Forage Science* 73: 907-917.

Cude, S.M., M.A. Ankeny, J. B. Norton, T.J. Kelleners, and C.F. Strom. 2018. Capillary barriers improve reclamation in drastically disturbed semiarid shrubland. *Arid Land Research and Management* 32:259-276.

Day, S.J., J.B. Norton, C.F. Strom, T.J. Kelleners, and E.F. Aboukila. 2018. Gypsum, langbeinite, sulfur, and compost for reclamation of drastically disturbed calcareous saline - sodic soils. *International Journal of Environmental Science and Technology* <https://doi.org/10.1007/s13762-018-1671-5>.

Norton, J.B. 2018. How does fertilizer use affect soil health? Wyoming Livestock Roundup, November.

Kasten, Mike. 2018. Grazing Influence on Wetland Extent and Soil Organic Carbon Storage in the National Trails Management Corridor of Central Wyoming. MS Thesis.

Badu. Mavis.2018. Compost and fertilizer carryover effect on GHG emissions and crop yields in winter wheat fallow planted with cover crops. PhD Dissertation.

Extension Materials

Norton, J.B.: Wyoming Soil Management Web Site: <https://soilmanagement.wordpress.com>.

Norton, J.B. and others: High Plains Organic Farming Conference Web Site: <https://www.highplainsorganic.org>.

Norton, J. B. (in re vision) Alkaline soils in Wyoming: Formation, ecology, and management of calcareous, saline, and sodic soils. UW Extension Bulletin.

Norton, J.B. 2018. Garden soil health handbook: Measuring and managing soil properties for Wyoming vegetable gardens. On-line Extension Bulletin: <https://soilmanagement.files.wordpress.com/2019/01/garden-soil-health-handbook-012319.pdf>.

Norton, J.B. 2018. Rangeland soil health indicators: A Stepwise guide to assessing management effects on rangeland sustainability. On-line Extension Bulletin: <https://soilmanagement.files.wordpress.com/2017/11/field-and-lab-soil-tests-for-rangeland-management2.pdf>.

Norton, U., Badu, M., J. Norton. 2018. Effect of high rate of compost or N fertilizer followed by cover crops on wheat yield and soil N. Agriculture Extension Field Days Bulletin.

Presentations

Norton, J.B., D. T. Booth, S.E. Cox, J. C. Likins. 2018. Grazing drives soil warming in herbaceous riparian wetlands. Annual Meeting, Society for Range Management, Sparks NV, January 31, 2018.

Booth, D.T., S.E. Cox, J.C. Likins, and J.B. Norton. 2018. Implications of Fall Grazing as Discussed in Riparian Area Management (BLM TR 1737 - 20). Annual Meeting, Society for Range Management, Sparks NV, January 31, 2018.

Kasten, M., J.B. Norton, K.L. Vaughan. 2018. Grazing management impacts on wetland soil carbon storage along the National Historic Trails Corridor in Wyoming. Annual Meeting, Society for Range Management, Sparks NV, January 31, 2018.

Norton, J.B. 2018. Build and maintain soil health for sustainable dry land production: Using compost and cover crops in the High Plains. 5th Annual High Plains Organic Farming Conference, February 28, 2018, Cheyenne, Wyoming.

Norton, J.B. 2018. Basic soil science for master gardeners, Casper, WY, October 27, 2018.

Norton, J.B. 2018. Basic soil science for master gardeners, Rock Springs, WY, March 22, 2018.

Norton, J.B. 2018. Basic soil science for master gardeners, Cheyenne, February 17, 2018.

Norton, U., M. Badu, J. Norton. 2018. Compost and cover crops carry-over effect on soil N mineralization and plant performance. Annual ASA - CSSA meeting, Baltimore, MD;

Badu, M., U. Norton, J. Norton. 2018. Compost and N fertilizer followed by cover crops on crop yield and weed species competition in winter wheat fallow production. Fifth Annual Great Plains Organic Farming conference, Cheyenne, WY

Badu, M., U. Norton, J. Norton, 2018. Seasonal changes to soil N and GHG fluxes in winter wheat fall ow after compost and N fertilizer application. Fifth Annual Great Plains Organic Farming conference, Cheyenne, WY.

Norton, U., Badu. M., J. Norton. 2018. Effect of high rate of compost or N fertilizer followed by cover crops on wheat yield and soil N. Agriculture Extension Station Field Days, Lingle, WY .