WERA-103 2017 Report for Meeting held March 1-3, 2017

Compiled State and Industry Submitted Reports

ALP-MAP-CAP Proficiency Programs, SPAC

Robert Miller, Colorado State University, Programs Coordinator

ALP Program

The Agricultural Laboratory Proficiency (ALP) program has one hundred twelve laboratories enrolled and 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 2016 from California, Mid Atlantic region and Romania, UAE and the Philippines. A new Fritsch jaw crusher was purchased in September. New warehouse space was added for the 163 soils has archived for future use in the program along with 2016 soil collections from: MT, ID, IA, IL, IN, KS, and AB. The Greenhouse media/solutions proficiency program will launch in April 2017 with fourteen labs. Nineteen laboratory site visits were conducted during 2016. A laboratory tour was conducted of testing labs in Illinois and Ohio August 29-30, 2016, with ten attendees. Another tour is scheduled for May 2017 of labs in the Pacific Northwest.

Accreditation of the ALP program was renewed with ANAB in September 2016. Collaboration with the sole the Illinois Soil Testing Association Laboratory Accreditation Program (ISTA-LAP). ALP was a sponsor at: the 2016 Joint Regional Soil Work Group Meeting in July; the 2017 Mid-Atlantic soil meeting in February and the NCERA-13 Laboratory Workshop in February.

Research studies

Lab evaluation of the CO_2 Solvita burst method was completed. Results utilizing ALP soils show issues associated with optimization of O_2, effects of texture and instability of the method. Results were presented at the Joint Regional Soil Work Group Meeting at Penn State University.

Manuscripts

Real-Time Soil CO_2 Respiration Rate Determination and the Comparison between the Infrared Gas Analyzer and Microrespirometer (MicroRes®) Methods, Andrew Sparda, Robert O. Miller, George Anderson and Yuch-Ping Hsieh, 2017. Results of the CO_2 Solvita burst research entitled Methodological Issues When Measuring Soil Microbial Respiration, has been drafted for publication, authors Jordan Wade, Steve Culman, Robert Miller and Luke Baker.

MAP and CAP Programs

The Manure Analysis Proficiency (MAP) administered by the Minnesota Department of Agriculture (MDA) program has 76 labs enrolled. Certification 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 twenty-two laboratories enrolled. Revisions have been completed on the USCC publication Test Methods for the Examination Composting and Compost, United States Compost Council (USCC) by Wayne Thompson.

Soil and Plant Analysis Council Activities

The 15th ISSPA meeting is scheduled for May 14-19, 2017, in Nanjing, China in conjunction with ASPAC of Australia-New Zealand. SPAC elected John Spargo as its new president elect and add three new board Members for the 2017-2018 term. The 16th ISSPA meeting is being organized for 2019 in The Netherlands.

Research

- Midwest corn K fertility research continues with support from WinField Solutions, Climate Corp., Fluid Fertilizer Foundation, Wilbur Ellis, Nachurs and PCS. In 2016 54 observation sites were installed grower fields across six Midwestern States to assess soil and plant K fertility. Summary results show optimum corn population at four of five locations was between 34,000 and 36,000 plts/ac during 2015-2016. Cluster analysis of ear leaf analysis from 131 site years K concentrations less than 1.9% have results in 45 bu/ac lower corn yields over five years. Sites with low ear leaf K showed elevated ear leaf Mg and substantially higher stalk Mg at crop maturity.

Arizona WERA-103 report

Jim Walworth, University of Arizona

Journal Articles

- Brown, P. W., Poro, J., & Ebdon, J. S. (2017). Effects of Mowing Height of Cut and Nitrogen on FAO-56 PM Crop Coefficients for Recreational Turf in the Cool-Humid Region. Crop Science, 57:1.

- Cendrero-Mateo, M. P., Moran, M. S., Papuga, S. A., Thorp, K. R., Alonso, L., Moreno, J., Ponce-Campos, G., Rascher, U, and Wang, G. (2016). Plant chlorophyll fluorescence: active and passive measurements at canopy and leaf scales with different nitrogen treatments. Journal of Experimental Botany, 67(1), 275–286.

- Fitzsimmons, K., & da Silva Cerozi, B. (2016). The effect of pH on phosphorus availability and speciation in an aquaponics nutrient solution. Bioresource Technology, 219, 778–781.

- Fitzsimmons, K., & da Silva Cerozi, B. (2016). Use of Bacillus spp. to enhance phosphorus availability and serve as a plant growth promoter in aquaponics systems. Scientia Horticulturae, 211, 277–282.

- Gebhardt, M., Fehmi, J. S., Rasmussen, C., & Gallery, R. E. (2017). Soil amendments alter plant biomass and soil microbial activity in a semi-desert grassland. Plant and Soil.

- Ghilishli, Fatemeh, Seydeh Zohreh Mirdeilami, Ezatolla Moradi, and Mohammad Pessarakli. 2016. Effects of Fertilizers on Plant Diversity, Density, and Uniformity in Golestan Rangelands. Journal of Plant Nutrition, 39(10): 1441–1448. http://www.tandfonline.com/doi/pdf/10.1080/01904167.2015.1109118

- Gleadow, R. M., Ottman, M. J., Kimball, B. A., Wall, G. W., Pinter, Jr, P. J., LaMorte, R. L., & Leavitt, S. W. (2016). Drought-induced changes in nitrogen partitioning between cyanide and nitrate in leaves and stems of sorghum grown at elevated CO_2 are age dependent. Field Crops Research, 185, 97–102.

- Haghighi, M., Nikbakht, A., & Pessarakli, M. (2016). Effects of Humic Acid on Remediation of the Nutritional Deficiency of Gerbera in Hydroponic Culture. Journal of Plant Nutrition, 39(5), 12.http://www.tandfonline.com/doi/pdf/10.1080/01904167.2015.1087560

- Haghighi, M., Sheibanirad, A., & Pessarakli, M. (2016). Effects of Selenium as a Beneficial Element on Growth and Photosynthetic Attributes of Greenhouse Cucumber. Journal of Plant Nutrition, 39(10), 6. http://www.tandfonline.com/doi/pdf/10.1080/01904167.2015.1109116

- Haghighi, Maryam and Mohammad Pessarakli. 2016. Copper (Cu) and Zinc (Zn) uptake by celery plants grown on acidic soil amended with biosolids. Journal of Plant Nutrition, 39(5): 655–665. DOI:10.1080/01904167.2015.1087029. http://www.tandfonline.com/doi/pdf/10.1080/01904167.2015.1087029

- Heerema, R. J., VanLeeuwan, D., Potter, M. T., Sherman, J. D., Comeau, M. J., & Walworth, J. L. (2016). Leaf Photosynthesis of Immature "Wichita" Pecan Trees is Improved by Soil-Application of Zinc-EDTA. Journal of the American Society for Horticultural Science. 142(1):27-35.

- Hewins, D. B., Sinsabaugh, R. L., Archer, S. R., & Throop, H. L. (2016). Soil-litter mixing and microbial activity mediate decomposition and soil aggregate formation in a sandy shrub-invaded Chihuahuan Desert grassland. Plant Ecology, DOI 10.1007/s11258-017-0703-4.

- Motamedi, A., Jafarpour, M., Askari-Khorasgani, O., & Pessarakli, M. (2016). Assessing the Potential of Pomegranate Meal and Potato Waste as New Organic Amendments for Vermicompost. Communications in Soil Science & Plant Analysis Journal, 47(15), 11. http://www.tandfonline.com/doi/pdf/10.1080/00103624.2016.1206924

- Saeidnejad, Amir Hossein, Mohammad Kafi, and Mohammad Pessarakli. 2016. Interactive Effects of Salinity Stress and Zn Availability on Physiological Properties, Antioxidants Activity and Micronutrients' Content of Wheat (Triticum Aestivum) plants. Communications in Soil Science & Plant Analysis, 47(8): 1048–1057. http://www.tandfonline.com/doi/pdf/10.1080/00103624.2016.1165831

- Sanchez, C. A., Zerihun, D., Subramani, J., Badaruddin, M., & Bronson, K. (2017). Fertigation uniformity under sprinkler irrigation: evaluation and analysis. Irrigation and Drainage Engineering Systems.

- Walworth, J. L., Comeau, M. J., & Heerema, R. J. (2016). Soil-Applied ZnEDTA: Vegetative Growth, Nut Production and Nutrient Acquisition of Immature Pecan Trees Grown in an Alkaline, Calcareous Soil. HortScience. 52(2):301–305.

- Xu, C., W, Z., J, H., & Van Leeuwen, W. J. (2016). Prediction of Soil Moisture Content and Soil Salt Concentration from Hyperspectral Laboratory and Field Data. Remote Sensing, 8(42).

Proceedings

- Heerema, R., & Walworth, J. L. (2016). Soil-Applied Zinc-EDTA: Photosynthesis in "Wichita" Pecan Grown on an Alkaline and Calcareous Soil. In 29th International Horticulture Congress (Vol. Acta Horticulturae). Brisbane Australia: International Society for Horticultural Science.

- Kacira, M., Jensen, M., Robie, T., Tollefson, S., & Giacomelli, G. A. (2016). Use resources wisely: waste management and organic liquid fertilizer use in greenhouse production system. In *III International Symposium on Organic Greenhouse Horticulture*.

- Kroggel, M., & Kubota, C. (2016). Controlled environment strategies for tipburn management in greenhouse strawberry production. In ISHS International Strawberry Symposium. ISHS (Acta Horticulturae).

- Walworth, J. L. (2016). Soil-Applied Zinc-EDTA: Growth and Nutrient Acquisition of Non-bearing Pecan Grown on an Alkaline and Calcareous Soil. In 29th International Horticulture Congress (Vol. Acta Horticulturae). Brisbane Australia: International Society for Horticultural Science.

Extension Publications

- Davenport, J., Flynn, R., & Walworth (2016). The Olsen Test for Phosphorus. New Mexico State University. https://youtu.be/zAJxcOLExW8

- Farrell-Poe, K. L., Walworth, J. L., & Pabedinskas, V. (2016). Backyard Composting. In Arizona Master Gardener Manual (p. 11). Arizona Cooperative Extension.

- Flynn, R. & Walworth, J. L. (2016). Unavailability of Water in Saline Soils. New Mexico State University. https://youtu.be/zJ_zi53UjF8

- Ottman, M. J., Sheedy, M. D., & Ward, R. W. (2016). Late season N application method effect on grain protein, 2016. College of Agriculture and Life Sciences, University of Arizona, Tucson. http://uacals.org/64d

- Walworth, J. L. & Flynn, R. (2016). Understanding the Sodium Adsorption Ratio (SAR). New Mexico State University. https://youtu.be/83qEk0sH8qo

- Walworth, J. L. & Flynn, R. (2016). Visualizing Soil Properties: Dispersion and Flocculation. New Mexico State University. https://www.youtube.com/watch?v=tLaJawbMrT0&feature=youtu.be

- Walworth, J. L., & Flynn, R. (2016). Visualizing Soil Properties: Gypsum and Sodic Soils. New Mexico State University. https://www.youtube.com/watch?v=NztGRuzgYsA&feature=youtu.be

California WERA-103 report

T. K. Hartz, University of California

Significant developments in nutrient management issues

State regulation of agricultural N continued to become more stringent. Concern over nitrate loading to groundwater has lead the Regional Water Quality Control Boards in the Central Valley and Central Coast regions (the main agricultural areas) to require annual nitrogen use reporting; individual growers are required to report total nitrogen application (all sources, including fertilizer, organic amendments and nitrate in irrigation water). The Regional Boards will use these data to calculate potential N loading to groundwater by estimating a partial N balance (N applied – N removed in harvest); N removed in harvest will be estimated using UC developed estimates of N content of the harvested portions of different crops. The expressed intent on the part of the Regional Boards is to use this information to identify inefficient growers so that intensive educational efforts can be effectively directed; however, lawsuits and political pressure groups continue to challenge the Regional Water Boards to set even stricter reporting requirements, and potentially to even numerically limit N loading rates. In 2016 large growers in both regions received 'cleanup and abatement' letters from the State Board requiring them to open negotiations to fund the provision of clean drinking water to rural residents whose wells are out of tolerance for nitrate concentration.

The California Department of Agriculture launched the 'Healthy Soils Initiative' (https://www.cdfa.ca.gov/oefi/healthysoils/). This is an effort to incentivize the use of soil building techniques such as cover cropping, addition of organic amendments, and reduced tillage. The intent behind this initiative is less to safeguard soil resources than it is to advance other governmental goals. California's GHG regulatory scheme is putting pressure on all industries, and agriculture is seen as a segment that may not only be able to reduce their GHG emissions, but may also have a significant potential to sequester carbon in soils. This dovetails with another state regulation governing the disposal of urban landscape waste, which no longer can be put in landfills; this initiative is intended to incentivize the agricultural use of urban green waste compost.

The University of California is comprehensively engaged in nutrient management issues linking crop and animal production methods with air and water quality concerns. A prime example of that engagement is the development and delivery of a two day nitrogen management training program for Certified Crop Advisors; the CDFA has mandated CCA attendance at this program in order to become certified to sign off on farm management plans required under water quality regulations. Six of these training courses have been delivered to date, to a total of >700 CCAs. This training program will continue to be offered 2017; after this year it is likely to be modified as an on-line program.

Another important UC project is the continuing development of CropManage, an on-line decision aid for irrigation and nitrogen fertilizer management (http://www.ucop.edu/information-technology-services/initiatives/sautter-award-program/sautter-2016/ANR-CropManage.pdf). The program currently covers a range of vegetable crops, including romaine lettuce, iceberg lettuce, broccoli (summer and winter plantings), cauliflower (summer and winter plantings), cabbage (red and green), spinach (baby, teen, bunch), celery, leaf lettuce, baby lettuce, mizuna, and peppers. Berries include strawberry, raspberry and blackberry. Work continues to add other crops, most notable processing tomato and almond.

Ongoing research

The CDFA Fertilizer Research and Education Program (FREP) continues to be the primary funding source for nutrient management research. Among ongoing FREP-sponsored projects are:

- Online Fertilization Guidelines for Agricultural Crops in California (15-0231)
- New Fertigation Book (15-0393)
- Developing a decision support tool for processing tomato irrigation and fertilization in the Central Valley based on CropManage (15-0410)
- Quantifying N2O Emissions under Different On-farm Irrigation and Nutrient Management BMPs that Reduce Groundwater Nitrate Loading and Applied Water (15-0356)
- Evaluation of the Multiple Benefits of Nitrogen Management Practices in Walnuts (15-0360)
- Train the Trainer: A Nitrogen Management Training Program for Growers (15-0392)
- Development of Management Training Curriculum for use in Grower Training for Self-Certification of Regional Water Board Nitrogen Management Plans (14-0585)

Additionally, several commodity groups (most notable the California Almond Board and the California Leafy Green Research Board) continue funding nutrient-related research, primarily regarding environmental stewardship issues.

Publications

- Adviento-Borbe, M.A. and B.A. Linquist. (2016) Assessing fertilizer N placement strategies for lower CH4 and N2O emissions in irrigated rice systems. Geoderma 266:40-45.
- Baram, S., V. Couvreur, T. Harter, M. Read, P.H. Brown, J.W. Hopmans, and D.R. Smart. 2016. Assessment of orchard N losses to groundwater with a vadose zone monitoring network. Agric. Water Manage. 172:83-95.
- Burger, M., V.R. Haden, J. Six and W.R. Horwath. 2016. Stand age affects emissions of N2O in flood-irrigated alfalfa: a comparison of field measurements, DNDC model simulations and IPCC Tier 1 estimates. Nutr. Cycl. Agroecosyst. 106:335-345.
- Geisseler, D. and G. Miyao. 2016. Soil testing for P and K has value in nutrient management for annual crops. California Agriculture 70:152-159.
- Hartz, T. 2016. California certified crop advisor exam study guide. Available at http://cacca.org/files/file_gallery/CCA%20study%20guide%20master%20Revised%20June%2015%202016.pdf
- Lagomarsino, A., A.E. Agnelli, B. Linquist, M.A.A. Adviento-Borbe, Agnelli, A., Gavina, G., and M. Ravaglia. (2016). Alternate wetting and drying of rice reduced CH4 but triggered N2O peaks in a clayey soil of central Italy. Pedosphere 26:533-548.
- LaHue, G.T., M.A. Adviento-Borbe, B.A. Linquist, C. van Kessel, and S.J. Fonte. (2016). Residual effects of N fertilization history increase N2O emissions from zero N controls: Implications for estimating fertilizer-induced emission factors. Journal of Environmental Quality 45:1501-1508.

- Lazcano, C., A. Tsang, T.A. Doane, G.S. Pettygrove, W.R. Horwath and M. Burger. 2016. Soil nitrous oxide emissions in forage systems fertilized with liquid dairy manure and inorganic fertilizers. Agric., Ecosyst. Environ. 225:160-172.

- Saa, S., E. Peach-Fine, P.H.Brown, Themis Michailides, S. Castro, R. Bostock and E. Laca. 2016. Nitrogen increases hull rot and interferes with the hull split phenology in almond (Prunus dulcis). Scientia Horticulturae. 199:41-48

- Smith, R., M. Cahn, T. Hartz, P. Love and B. Farrara. 2016. Nitrogen dynamics of cole crop production: implications for fertility management and environmental protection. HortScience 51:1586-1591.

- Ye, R., Espe, M., Linquist, B., Parikh, S.J., Doane, T.A., Horwath, W.R. (2016) A soil carbon proxy to predict CH4 and N2O emissions from rewetted agricultural peatlands. Agriculture, Ecosystems and Environment 220:64-75.

Conference Proceedings

- 24th Annual Fertilizer Research and Education Program Conference Proceedings. California Dept. of Food & Agriculture. October 26-26, 2016. Modesto, CA. 94 pages. https://www.cdfa.ca.gov/is/ffldrs/frep/pdfs/2016_Proceedings_FREP.pdf .

- California Plant and Soil Conference, 2016 Conference Proceedings, Feb. 2-3, Visalia, CA. 195 pages. California Chapter American Society of Agronomy. http://calasa.ucdavis.edu/files/250178.pdf .

Web resources

FREP Database:

The California Department of Food & Agriculture's Fertilizer Research and Education Program (FREP) has created a searchable database of its projects funded since its inception in 1990. http://www.cdfa.ca.gov/is/frep/default.aspx.

Additionally, FREP has added additional crop modules to its crop fertilization modules, summarizing crop-specific research on nutrient management. http://apps.cdfa.ca.gov/frep/docs/Guidelines.html .

CCA study guide:

Tim Hartz created a study guide for aspirants to the California Certified Crop Advisor program

http://cacca.org/files/file_gallery/CCAStudyGuideOct15.pdf

UC Cooperative Extension Specialist Mark Lundy participated in the creation of a website on nutrient management and water quality issues. http://agwaterstewards.org/index.php/practices/nutrient_management

UC Cooperative Extension Farm Advisor Michael Cahn has created a web-based decision tool to aid vegetable and strawberry growers in irrigation and nutrient management. Currently modules for lettuce, broccoli, cabbage, cauliflower, spinach and strawberry are functional. http://ucanr.edu/blogs/CropManage/

Powerpoint presentations and other material is available at the UC website developed as part of our CCA nitrogen training program.

http://ciwr.ucanr.edu/NitrogenManagement/

Lastly, The UC Agricultural Sustainability Institute has created the 'Solutions Center', a website developed as a clearinghouse for nutrient management information.

http://ucanr.edu/sites/Nutrient_Management_Solutions/stateofscience/Nitrogen_management_in_California_agriculture/

Colorado WERA-103 report
Colorado State University
Troy Bauder and Jim Ippolito

- Bridging the gap between wide-area assessment and farm level conservation planning;

Objectives: Demonstration in priority Colorado watersheds; Mazdak Arabi; Demonstrate the enhanced accessibility of the APEX and SWAT models for conservation assessment and planning in Colorado watersheds using the open source participatory geographic information system eRAMS (http://erams.com) is a participatory GIS that operates on a web platform and requires no hardware and software installation. Contact: Mazdak.Arabi@ColoState.Edu

- Center for Comprehensive, optimaL and Effective Abatement of Nutrients Water Quality and Nutrient Management BMPs (CLEAN); Mazdak Arabi, Deanna Osmond, Troy Bauder;

Objectives: To understand how effectiveness of agricultural BMPs for N and P control varies with the selected practices, their landscape position, physical characteristics of the farm, proximity to perennial streams, irrigation ditches, and other factors; to understand and characterize socioeconomic factors that influence (facilitate or impede) adoption of agricultural BMPs; to develop a simple and practical model based on the SWAT model for representation of BMPs at field, irrigation district, and watershed scales and then identify simple and transparent approaches for incorporating watershed-scale benefits of conservation. troy.bauder@colostate.edu

- Improved Assessment of Nitrogen and Phosphorus Fate and Transport for Irrigated Agricultural Watersheds in Semiarid Regions; Mazdak Arabi, Ryan Bailey, and Timothy Gates

Objectives: The overarching goal of the proposed project is to improve the modeling capacity to analyze the movement, transformation, and storage of N and P species in highly managed irrigated agricultural systems, particularly in areas susceptible to severe drought events. Contact: Mazdak.Arabi@ColoState.Edu

- Optimizing On-farm Production and Utilization of Cyanobacterial Bio-fertilizer in Irrigated Vegetables; Davis, J. G.; Stonaker, F. H.; Conant, R. T.; Stromberger, M. E.; Storteboom, H. N.

Objectives: 1) Test an on-farm cyanobacterial bio-fertilizer production system and optimize the yield, efficiency, and productivity of cyanobacteria 2) Evaluate the utilization of cyanobacterial bio-fertilizer as both a solid and liquid fertilizer in irrigated vegetable production systems in order to maximize the vegetable yield, efficiency, and productivity 3) Quantify the carbon footprint of commonly-used organic and conventional fertilizers and cyanobacterial bio-fertilizer. Contact: Email: jessica.davis@colostate.edu

- Plant Mediation of Nitrogen Mineralization via Shifts in Rhizosphere Carbon Allocation; Schipanski, M.

Objectives: Quantify the influence of cover crops on the carbon (C) allocation in succeeding cash crops, nitrogen (N) mineralization, and cash crop productivity.

- Precision Nutrient and Water Management across Spatial Variable Landscapes for Enhancing Nutrient and Water Use Efficiencies, Farm Profitability and Environment Sustainability; Khosla, R.; Reich, R. M.; Longchamps, L.

Objectives: 1. Quantify spatial and temporal variability in soils for delineating water management zones via precision irrigation systems to enhance and/or maintain grain production, while conserving soil and water and improving water-use-efficiency. 2. Quantify spatial and temporal variability in crop canopies, utilizing a suite of active sensor devices (i.e., reflectance, ultrasonic, fluorescence, moisture sensors, etc.) for in-season precision nutrient (nitrogen) management. 3. Make agronomic and economic comparisons in terms of grain production, water and nutrient use efficiencies, conventional practice of uniform application of water and nutrients. Contact: raj.khosla@colostate.edu

- Soil-based Use of Residuals, Wastewater and Reclaimed Water; Ippolito, J.A.; Barbarick, K. A.; Borch, T.

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

- Uncovering the mechanisms of reduced tillage effects on nutrient cycles and greenhouse gas flux; Brewer, PA.

Objectives: The objectives of this study are to, 1) determine how strong greenhouse gas (ie, N_2O and CH_4) production is regulated by soil properties, 2) examine the potential for soils under different tillage to produce strong greenhouse gases, and, 3) build an ecosystem sub-model to explain and predict how tillage affects greenhouse gases across a range of soils and climates. paul.brewer@colostate.edu

- Yield and Water Quality as Affected by Conservation Tillage and Nutrient Management Under Furrow Irrigation; Troy Bauder, Erik Wardle and Neil Hansen

Objectives: 1) Compare cropping inputs, fertilization requirements, weed control, labor, and equipment costs between conventional, no-till and strip-tillage systems under furrow irrigation. 2) Evaluate water quality (N, P, and sediment loads) in runoff between conservation systems. Contact: troy.bauder@colostate.edu

Publications:

- Barminski, R., H. Storteboom, and J.G. Davis. 2016. Development and evaluation of an organically-certifiable growth medium for cyanobacteria. J. Appl. Phycol. 28:2623-2630. DOI 10.1007/s10811-016-0819-2.

- Barbarick, K.A., J.A. Ippolito, and J. McDaniel. 2016. Path Analysis of grain P, Zn, Cu, Fe, and Ni in a biosolids-amended dryland wheat agroecosystem. J. Environ. Qual. 45:1400-1404.

- Elzobair, K.A., M.E. Stromberger, and J.A. Ippolito. 2016. Stabilizing effect of biochar on soil extracellular enzymes after a denaturing stress. Chemosphere. 142:114-119.

- Elzobair, K.A., M.E. Stromberger, J.A. Ippolito, and R.D. Lentz. 2016. Contrasting effects of biochar versus manure on soil microbial communities and enzyme activities in an Aridisol. Chemosphere. 142:145-152.

- Ippolito, J.A., M.E. Stromberger, R.D. Lentz, and R.S. Dungan. 2016. Hardwood biochar and manure co-application to a calcareous soil. Chemosphere. 142:86-91.

- Ippolito, J.A., T.F. Ducey, K.B. Cantrell, J.M. Novak, and R.D. Lentz. 2016. Designer, acidic biochar influences calcareous soil characteristics. Chemosphere. 142:184-191.

- Novak, J.M., J.A. Ippolito, R.D. Lentz, K.A. Spokas, C.H. Bolster, K. Sistani, K.M. Trippe, and M.G. Johnson. 2016. Soil health, crop productivity, microbial transport, and mine spoil response to biochars. Bioenerg. Res. 9:454-464.

- Toonsiri, P., S.J. Del Grosso, A. Sukor, and J.G. Davis. 2016. Greenhouse gas emissions from solid and liquid organic fertilizers applied to lettuce. J. Environ. Qual. 45:1812-1821. DOI:10.2134/jeq2015.12.0623

- Tsekeke, A., T. Degefu, E. Wolde-Meskel, and J. Davis. 2016. The effect of pond depth and lining plastic color on nitrogen fixing capacity of cyanobacteria, Anabaena strain E3. African Journal of Biotechnology 15: 1442-1451. DOI: 10.5897/AJB2015.15173.

HAWAII WERA-103 report

University of Hawaii, Jonathan L. Deenik

Administration

Dr. Novotny (Nutrition) current interim Dean. Interviews for three finalists concluded

Kelvin Sewake (Plant Pathology, extension agent) interim Associate Dean for Extension

Research Update

Cover Cropping

Dr. K H. Wang, Assistant Researcher in the Department of Plant and Environmental Protection Sciences, continues to engage in two NRCS-CIG funded cover cropping projects. The more recent is focused on no-till cover cropping systems and their effects on water use efficiency and the other is adapting the cover crop calculator developed at Oregon State to the tropics for improved nitrogen management.

Biochar

Drs Deenik and Crow are finishing up a NIFA funded biochar project investigating the effects of biochar on greenhouse gas emissions, nutrient cycling, microbial community structure, and effectiveness to alleviate Mn toxicity through field, greenhouse and laboratory studies. Dr. Hue secured WSARE funds to improve nitrogen synchronization of local fertilizers, soil fertility, and crop quality with biochar application.

Web-based Agricultural/Ecological Decision Support System

Dr. Deenik continues to work with extension to develop GIS-based maps to assist in land use decision making. A series of web-based maps on pasture suitability for grass-fed beef production for each island have been produced. A small grant was secured to HI-CROP Web Mapper, a GIS-based software to display crop suitability maps for the Hawaiian Islands (http://gis.ctahr.hawaii.edu/CropSuitability). Modules for coffee and sweet potato are availabkle for the Big Island, and work has begun to refine the database and algorithms and expand capability to all islands and include, breadfruit, corn, soybean, cabbage and onion.

Nutrient Managent

- *Fruit trees*: Dr. Alyssa Cho has begun a research program on integrated pest and nutrient management in macadamia nut orchards to maintain the productivity of the orchards and ensure longevity of the industry.

- *Indigenous Cropping Systems*: New hire Dr. Noa Lincoln's research examines indigenous crops and cropping systems in both the past and present. He studies pre-historical agriculture in the Pacific using soil science, ethnohistory, and archaeology to examine how humans and the environment interacted in pre-industrial societies as part of the Human Biocomplexity Project. He works closely with traditional farmers, restoration of traditional farming systems, and other farms that utilize traditional crops or cropping systems. Through this works he preserves traditional knowledge and practices by incorporating them into modern farming systems, bringing the lessons of the past to bear on modern issues of food and farming. Current funded project is investigation nitrogen fixation in sugar cane sweet potato systems.

- *Nitrogen fertilizer and irrigation scheduling*: Drs. Deenik and Batemi (hydrologist in Civil Engineering in collaboration with Dr. Cahn (UC Davis) secured NRCS-CIG grant funds to adapt the CropManage decision support tool to Hawaii vegetable farms.

Organic Farming

Dr. Radovich and his lab continue to work on characterizing the agronomic value of various locally available organic fertilizer inputs.

Journal Publications

- Berek, A.K. and N.V. Hue. 2016. Characterization of biochars and their use as an amendment to acid soils. Soil Science 181(9/10):412-418

- Hue, N.V and A. Ahmad. 2017. Arsenic reactions and brake fern (Pteris vittata L.) uptake in tropical soils. Plant, Soil and Environment. *In Press*.

- Long, M.S., C.M. Litton, C.P. Giardina, J. Deenik, R.J. Cole, and J. Sparks. 2017. Impact of nonnative feral pig removal on soil structure and nutrient availability in Hawaiian tropical montane wet forests. Biol Invasions *In Press*

- Paudel, C. Chan, J. Halbrendt, S.E. Crow, and G. Norton. 2016. Bioeconomic optimization of conservation agriculture production systems (CAPS) for smallholder tribal farmers in the hill region of Nepal. J. Soil and Water Conser. 71(2):102-117.

- Quintanolla-Tornel, M.A., K.H. Wang, J. Tavares, and C.R.R. Hooks. 2016. Effects of mulching on above and below ground pests and beneficials in a green onion agroecosystem. Ag Agroecosys Env. 224:75-85.

- Shuai, X., X. Li, R.S. Yost, and O. Wentworth. 2016. State-Space Estimation of the Intrinsic Soil Phosphorus Pools from the Mehlich-3 Test. Comm. Soil Sci. Plant Anal. 47(8):1058

- Wang, P., Z. Hu, R.S. Yost, F. Shao, J. Liu, and X. Li. 2016. Assessment of chemical properties of reclaimed subsidence land by the integrated technology using Yellow River sediment in Jining, China. Environmental Earth Sciences 75:1046

Extension Publications

- Fukumoto, G.K., M.S. Thorne, J.H. Silva, J. Deenik, and M.H. Stevenson. 2016. Suitability Map for Forage-Finished Beef Production Using GIS Technology: Kauai County. Cooperative Extension Service Publication, CTAHR, PRM-10, pp. 6.

- Fukumoto, G.K., M.S. Thorne, J.H. Silva, J. Deenik, and M.H. Stevenson. 2016. Suitability Map for Forage-Finished Beef Production Using GIS Technology: Maui County. Cooperative Extension Service Publication, CTAHR, PRM-9, pp. 8.

- Fukumoto, G.K., J. Deenik, M. Hura, and M. Kostka. 2016. Piggery Impacts to Water Quality of Streams in Pohnpei,Federated States of Micronesia. Cooperative Extension Service Publication, CTAHR, WI-3, pp. 9.

IDAHO WERA-103 report

Amber Moore, University of Idaho and David Tarkalson, USDA-ARS

Ongoing Research:

Fertilizers and Water Use

- Optimizing Water and Nitrogen Use for Sustainable Wheat Production. Walsh O.S. and X. Liang, in collaboration with J.A. Torrion (MSU)
- Water and Soil Conservation and Effective Weed Management for Sustainable Dry Bean and Garden Bean Production. Walsh O.S., D. Morishita, and H. Neibling
- Updating corn nitrogen recommendations in the Pacific Northwest. David Tarkalson, Dave Bjorneberg, and Olga Walsh

Fertilizers, manures and compost

- Sustainable Cropping Systems for Dual-Purpose Biennial Canola. Walsh O.S., in collaboration with R. Ondoua (MSU) and S. Fransen (WSU)

Unmanned Aerial Systems

- Precision Sensing for Improved Wheat Production. Walsh O.S. and J. Marshall

Soil and seed amendments

- Evaluation of Seed Coating Treatments in Soft White Winter Wheat. Walsh O.S. with the J.R. Simplot Company.
- Potential of Silica Amendments for Improved Wheat Production. Walsh O.S. with MontanaGrow
- Evaluation of Micronutrients in Winter Wheat. Walsh O.S. with the Mosaic Company
- Alfalfa Fertility Trial. Walsh O.S. with the Mosaic Company
- Evaluation of NZoneMax in Corn. Walsh O.S. with the AgXplore International

Cover Crops

- Evaluation of Cover Crops for Improved Soil Health in Silage Corn Cropping System in Idaho. Walsh O.S. with the J.R. Simplot Company

Publications:

Research

- Walsh O.S., and K. Girma. 2016. Environmentally Smart Nitrogen Performance in Northwestern Great Plains' Spring Wheat Production Systems. *International Journal of Agriculture.* doi:10.1155/2016/8969513.

- Pishchik V.N., N.I. Vorobyov, O.S. Walsh, V.G. Surin, and Y.V. Khomyakov. 2016. Estimation of Synergistic Effect of Humic Fertilizer and Bacillus Subtilis on Lettuce Plants by Reflectance Measurements. 2016. *Journal of Plant Nutrition.* doi: 10.1080/01904167.2015.1061551.

- Samborski S. M., D. Gozdowski, E.S. Dobers, M. Stępień, O.S. Walsh, and E. Leszczyńska. 2016. On-Farm Evaluation of an Active Optical Sensor Performance for Variable Nitrogen Application in Winter Wheat. *European Journal of Agronomy*. (74):56–67.

    - Tarkalson, D.D., and Bjorneberg, D.L. 2016. Effect of phosphorus placement methods and rates on sugarbeet production under strip tillage in southern Idaho. Crop, Forage, & Turfgrass Management. Vol. 2. doi:10.2134/cftm2015.0183.

    - Tarkalson, D.D., Bjorneberg, D.L., Moore, A. 2016. Fall and spring tillage effects on sugarbeet production. Journal of Sugar Beet Research. 52:30-38.

    - Tarkalson, D.D., Bjorneberg, D.L., Camp, S., Dean, G., Elison, D., and Foote, P. 2016. Improving nitrogen management in Pacific Northwest sugarbeet production. Journal of Sugar Beet Research. Journal of Sugar Beet Research. 53:14-36.

Extension publications

- Brown B. and O.S. Walsh. 2016. Planting Dates in Wheat Production. Bulletin 906. University of Idaho. 10 pp.

- Walsh O.S. 2016. Recap of the Nitrogen Use Efficiency Conference. CSA News Magazine. 61. pp. 28-29.

- Walsh O.S. 2016. Unmanned Aerial Imagery and Ground-Based Crop Sensors for Improved Nitrogen Management in Wheat. Crops & Soils. pp. 30-33.

    - Tarkalson, D.D., Bjorneberg, D., Camp, S., Dean, G., Elison, D., and Foote, P. 2016.Improving nitrogen recommendations in Pacific Northwest sugarbeet production. Crops and Soils. 49:4-7.

Proceedings and Abstracts

- Walsh O.S., J. R. McClintick-Chess, and S.M. Blanscet. 2016. Evaluation of NZone Max Nitrogen Aid in Corn. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O.S., J. Marshall, C. Jackson, J.R. McClintick, S.M. Blanscet, C. Thompson, and K. Swoboda. 2016. UAV - Based Scouting for Precision Nitrogen Management in Wheat. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O.S., J.A. Torrion, X. Liang, J. R. McClintick-Chess, and S.M. Blanscet. 2016. Sensor-Based Technologies for Improving Water and Nitrogen Use Efficiency. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O.S., J. R. McClintick-Chess, and S.M. Blanscet. 2016. Evaluation of Micro Carbon Technology® - Based P Fertilizer, Super Phos® in Spring Wheat. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O.S., J. R. McClintick-Chess, and S.M. Blanscet. 2016. Potential of Silicon Amendment for Improved Wheat Production. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O.S., J. R. McClintick-Chess, and S.M. Blanscet. 2016. Foliar Application of Agxplore Prevent Phosphorus Aid in Winter Wheat. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O.S., J. R. McClintick-Chess, and S.M. Blanscet. 2016. Evaluation of Seed Coating Treatments in Soft White Winter Wheat. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Xi Liang, Olga Walsh, Jessica A Torrion, Hossein Sadeghi and Howard Neibling. 2016. Developing Efficient Deficit Irrigation and Nutrient Management Strategies for Spring Wheat Grown in Southeastern Idaho, USA. *Proc. of the ASA-CSSA-SSSA International Annual meetings.*

- Walsh O. S., K. Belmont, J. McClintick-Chess. 2016. Sensor-Based Technologies for Improving Water and Nitrogen Use Efficiency. *Proc. International Conference on Precision Agriculture.*

- Walsh O. S., K. Belmont, J. McClintick-Chess, J. Marshall, C. Jackson, C. Thompson, and K. Swoboda. 2016. UAV-Based Crop Scouting for Precision Nutrient Management. *Proc. International Conference on Precision Agriculture.*

- Samborski S. M., D. Gozdowski, O. S. Walsh, D. W. Lamb, M. Stępień, E. S. Gacek, T. Drzazga. 2016. Winter Wheat Genotype Effect on Canopy Reflectance: Implications for Using NDVI for In-Season Nitrogen Topdressing Recommendations. *Proc. International Conference on Precision Agriculture.*

- Samborski S. M., D. Gozdowski, M. Stępień, O. S. Walsh, E. Leszczyńska. 2016. On-Farm Evaluation of an Active Optical Sensor Performance for Variable Nitrogen Application in Winter Wheat. *Proc. International Conference on Precision Agriculture.*

- Walsh O.S., J. Marshall, C. Jackson, J.R. McClintick, S.M. Blanscet, C. Thompson, and K. Swoboda. 2016. UAV - Based Scouting for Precision Nitrogen Management in Wheat. *Proc. of the Western Crop Science Society Conference.*

- Walsh O.S., K.M. Belmont, J.R. McClintick-Chess. 2016. Improving Water and Nitrogen Use Efficiency in Wheat. *Proc. Idaho Nutrient Management Conference.*

- Tarkalson, D.D., Bjorneberg, D., Hines, S., and Moore, A. Adjusting nitrogen requirements for sugarbeet. 2016. *In:* A. Moore (ed.) Proceedings of the 2016 Idaho Nutrient Management Conference, Twin Falls, ID, March 10, University of Idaho, Moscow, ID.

POSITION ANNOUNCEMENT:

Postdoctoral fellow: Cropping Systems Agronomy program at UI Parma R&E Center is seeking an individual to assist with yield potential prediction for major crops grown in Idaho using hand-held remote sensing methodologies and unmanned aerial systems. The yield potential prediction information will be utilized to develop sensor-based fertilizer recommendations and improve nutrient use efficiency for Idaho crops. Contact: Olga Walsh, owalsh@uidaho.edu.

MINNESOTA WERA-103 report

University of Minnesota

In Minnesota there is a multi-year investment by the state legislature that is providing the University of Minnesota financial support to build on our agricultural capacity. The Agricultural Research, Education, Extension and Technology Transfer Program (AGREETT) is currently providing funds to hire three new faculty positions in Department of Soil Water, and Climate in the area of nutrient management: Soil Fertility and Precision Nutrient Management (50% Teaching and 50% Research), Manure Management & Water Quality Specialist (60% extension and 40% research), and Nutrient and Water Management specialist in Crookston (60% research and 40% extension). Also, MDA through the Clean Water Funds has provided support to hire an Irrigation Specialists. This is an assistant Extension Professor with 100% extension responsibilities.

Publications

- Corn Nitrogen Management Influences Nitrous Oxide Emissions in Drained and Undrained Soils. Fernandez F.G., R.T. Venterea, and K.P. Fabrizzi. Journal of Environmental Quality.

- Nitrogen Management for Corn Groundwater Quality in Upper Midwest Irrigated Sands. Struffert A.M., J.C. Rubin, F.G. Fernandez, and J.A. Lamb. Journal of Environmental Quality.

- Maize Yield and Nitrogen Use Efficiency in Upper Midwest Irrigated Sandy Soils. Rubin J.C., Struffert A.M., F.G. Fernandez, and J.A. Lamb. Agronomy Journal.

MONTANA WERA-103 report

Montana State University

Clain Jones

Personnel changes:

- Dr. Maryse Bourgault, Assistant Professor/Cropping Systems, was hired at the Northern Ag Research Center in Havre. Maryse obtained her Ph.D. at McGill University and most recently worked at the University of Melbourne.

- Dr. Jed Eberly, Assistant Professor/Soil Microbiology, was hired at Central Ag Research Center in Moccasin. He worked most recently at the US Army Corps Environmental Research Lab in Mississippi. His Ph.D. is from Oregon State University.

- Dr. Roger Nkoa Ondoua is no longer at the Western Triangle Ag Research Center in Conrad. A search has begun for a superintendent/agronomist at the associate professor level who will conduct mainly nutrient management research. Contact Clain (clainj@montana.edu) for more details on this position.

Ongoing research

- Nitrate Leaching – Dr. Stephanie Ewing, Dr. Clain Jones, Dr. Perry Miller and Adam Sigler attained funding from the Montana Fertilizer Check Off to continue portions of their USDA grant to study effects of best management practices on nitrate leaching in the Judith Basin. Treatments include fallow, pea, and barley. Nitrate leaching rates have been measured at both field scale and watershed scale, on very shallow (<43 cm) and moderately shallow (53-105 cm) soils.

- 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.

- Cover crop cocktails – Dr. Miller, Dr. Jones, and Dr. Zabinski 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. Dr. Darrin Boss (NARC) is also studying mixed cover crops, but using mowing or grazing as additional termination strategies. All researchers are specifically investigating the effect of plant functional groups on subsequent yield and soil quality.

- Enhanced Efficiency Fertilizers - Peggy Lamb and Dr. Boss evaluated Agrotain, ESN, NSN, and urea on dryland corn. Dr. Rick Engel is evaluating N placement and source on winter wheat.

- Selection of high nutrient use efficiency cultivars – Dr. Roger Nkoa Ondoua focused on nutrient acquisition and nutrient use efficiencies, and screening and identification of low-P and low-N spring wheat varieties. Recent advances in plant molecular biology have elucidated the mechanisms by which plant species adapt to low-nitrogen and low-phosphorus environments. This has paved the way to new perspectives and strategies for screening and identifying low-nitrogen and low-phosphorus cultivars in order to optimize N and P acquisition and use efficiencies and enhance economic and environmental sustainability. Dr Ondoua's team collected 100 spring wheat varieties from across the world comprising elite varieties and landraces, and built a high tunnel greenhouse for the initial screening.

- Soil acidification – Drs. Engel and Jones are investigating extent of, and mitigation practices for, soil acidification in the Highwood Bench area in Choteau County that are likely a result of nitrification from ammonium fertilizers. Soil pH levels as low as 4.0 have been measured in upper 15 cm.

- Optimizing boron maintenance fertilization for alfalfa- Drs. Emily Glunk, Jessica Torrion, Mr. Anish Sapkota, and Ms. Danielle Staudenmeyer initiated a trial in summer of 2015. The objectives of this project were to: 1) determine alfalfa crop response in yield and quality to different boron (B) application rates, and 2) identify optimum timing of B applications. After analyzing 2 years of data, it was obvious that there was a significant impact of soil water availability on nutrient uptake and plant response, so in 2016, a third objective was added, looking to evaluate the impact of water availability on B uptake in alfalfa. Specifically, in the first cutting in 2016, it was found that B application influenced alfalfa quality yet not yield. At the second and third cutting, no B effect on both yield and quality was observed at any given water regime. It was also found that yield of 50 percent evapotranspiration (ET) irrigation strategy treatment was equivalent to 100 percent ET.

- Variety specific-response to N x water levels. Drs. Torrion and Bob Stougaard found that in Northwestern MT, there is a wide variability of varietal response to N x water associations. In particular, the spring wheat variety Volt was a superior variety across N x water, whereas, Brennan is the least responsive among the eight spring wheat varieties evaluated. They have just started looking at the NUE/WUE tradeoff and what this means in terms of optimizing the use of both water and N. A similar study was conducted in 2016 by Drs. Torrion, Stougaard, and Luther Talbert to characterize the change of plant N economy in Egan – a newly commercialized high grain protein content variety with high protein gene *Gpc-B1* of Montana State University. This study will be conducted in 2 parts. First, at both irrigated and dryland sites, various N rates and Egan will be evaluated with other hard red and soft white varieties. The second will be a factorial experiment of N x water levels on Egan. In 2016, 100 lb available N/acre was sufficient to achieve high yield in either irrigated or rainfed research sites for both hard red and soft white spring wheat. Specifically soft whites had significantly higher yield than hard reds. The high protein Egan variety had mostly comparable yield with other hard red spring wheats, except, McNeal – which had higher yield in irrigated plots, and Vida – which had higher yield in rainfed plots. The irrigated income was the same either at 100 or 138 lb available N/acre, whereas, 100 lb available N/acre was more economical in the rainfed site despite lower protein. Egan consistently had high protein across water and nitrogen levels. The factorial experiment of N x Water on Egan showed that the optimal N x water for yield was 100 lb available N/acre at 50% ET – which also achieved protein greater than 14.8%.

- Indicator plants to diagnose nutrient deficiencies Dr. David Sands is screening 600 lines of barley seeds to learn which ones react negatively to a specific soil deficiency. A “seed strip”, will be planted by a farmer. Approximately two weeks later, the farmer can compare the complete seed with the deficient indicator seed to determine if there is a deficiency. Each indicator plant shows sensitivity to a deficiency of the bioavailability of one mineral nutrient in the soil.

Journal publications

- Anderson E.K., E. Aberle, C. Chen, J. Egenolf, K. Harmoney, V.G. Kakani, R. Kallenbach, M. Khanna, W. Wang, and D.K. Lee. 2016. Impacts of management practices on bioenergy feedstock yield and economic feasibility on conservation reserve program grasslands. GCB Bioenergy. doi: 10.1111/gcbb.12328

- Huang J.W., R. Keshavarz Afshar, C. Chen. 2016. Lentil response to nitrogen application and rhizobia inoculation. Communications in Soil Science and Plant Analysis. 47:2458-2464. DOI:10.1080/00103624.2016.1254786. http://dx.doi.org/10.1080/00103624.2016.1254786.

- Keshavarz Afshar R., Y.A. Mohammed, and C. Chen. 2016. Enhanced efficiency nitrogen fertilizer effect on camelina production under conventional and conservation tillage practices. Industrial Crops and Products. 94: 783–789. http://dx.doi.org/10.1016/j.indcrop.2016.09.043

- Mohammed Y.A., C. Chen, and T. Jensen. 2016. Urease and nitrification inhibitors impact on winter wheat fertilizer timing, yield, and protein content. Agron. J. 108:1-8. doi:10.2134/agronj2015.0391.

Extension publications

- Jones, C., and K. Olson-Rutz. 2016. Soil Nutrient Management for Canola. EB0224. 12 p. http://landresources.montana.edu/soilfertility/documents/PDF/pub/CanolaEB0224.pdf

- Jones, C., and K. Olson-Rutz. 2016. Plant Nutrition and Soil Fertility. MSU 4449-2. 12 p. Extensive revision. http://landresources.montana.edu/nm/documents/NM2.pdf

- Engel, R., and C. Romero. Nitrogen Recovery from Broadcast Urea is Affected by Application Timing and Agrotain. Editors C.A. Jones K. Olson-Rutz. Fertilizer e-Fact 71. February 2016. MSU Extension. Bozeman MT. 2 p. http://landresources.montana.edu/FertilizerFacts/.

- The Soil Scoop, found at http://landresources.montana.edu/soilfertility/thesoilscoop.html, all are 2 pages.

    - Jones, C., and R. Kurnick. Fertilizer rate calculations.

    - Jones, C., and K. Olson-Rutz. Reducing N fertilizer loss to air.

    - Jones, C., and K. Olson-Rutz. Nitrogen management for grain protein.

    - Jones, C., and K. Olson-Rutz. Nitrogen management for grain yield.

    - Jones, C., and K. Olson-Rutz. Soil fertility for pulse crops.

    - Jones, C., and K. Olson-Rutz. Canola: nitrogen & sulfur.

    - Jones, C., and K. Olson-Rutz. Canola: P, K, and micronutrients.

    - Jones, C., and K. Olson-Rutz. Soil acidification: problems, causes, & testing.

    - Jones, C., and K. Olson-Rutz. Soil acidification: management.

Proceedings, Abstracts and presentations (* - presenter)

- Jones, C.*, P. Miller, M. Housman, S. Tallman, and C. Zabinski. 2016. Cover crop diversity: how important is it for soil quality and the subsequent crop? American Society of Agronomy Annual Conference Abstracts. Phoenix, AZ. Nov 6-9, 2016.

- Jones, C.*, A. John, S. Ewing, P. Miller, and W.A. Sigler. 2016. Nitrate leaching and economic benefits of pulse crops as fallow replacement on shallow soils in central Montana. Great Plains Soil Fertility Conference Proceedings. Denver, CO. Mar 1-2, 2016. 16: 56-61.

- Jackson-Smith, D.*, S. Ewing, C. Jones, and W.A. Sigler. 2016. The Road Less Travelled: Assessing the impacts of in-depth farmer and stakeholder participation in nitrate pollution research. Annual Meetings of the Rural Sociological Society. Toronto, Canada. Aug 7-10, 2016.

- McVay, K.A. 2016. Malt Barley Response to Nitrogen Fertilizer. Southern Agricultural Research Center Field Day, June 28, 2016, Huntley, MT.

- McVay, K.A. 2016. Effect of Mixed Cover Crop Functional Groups on Barley Yield and Quality. Southern Agricultural Research Center Field Day, June 28, 2016, Huntley, MT.

- Miller, P.*, R. Engel, J. Holmes, M. Housman, C. Jones, S. Tallman, and C. Zabinski. 2016. Cover crops in Montana – buying land. Proc. Great Plains Soil Fertility Conf. Denver, CO. Mar 1-2, 2016. 16:89-95.

- Romero, C., R. Engel, C. Chen, and R. Wallander. 2016. Great Plains Soil Fertility Conference, "Fertilizer15N recovery in semiarid no-till winter wheat", Denver, CO. Mar1-2, 2016. 16:214-221.

- Sigler, W.A.*, S. Ewing, R. Payn, C. Jones, J. Brookshire, J. Klassen, D. Jackson-Smith, and G. Weissmann. 2016. Connecting soil water to groundwater to streams: understanding controls of nitrate losses from a dryland agricultural landscape in the upper Missouri River watershed. American Geophysical Union Fall Meeting. San Francisco, CA. Dec 12-16, 2016.

New Mexico WERA-103 report

New Mexico State University

Robert Flynn

New Hires (Plant and Environmental Sciences Department):

- Colby Brungard: primary research interest is to couple quantitative soil spatial information from digital soil mapping with environmental process modeling to refine our understanding of the biophysical land processes that influence managed and natural ecosystems.

- Niall Hanan: New Mexico State University Plant and Environmental Sciences Department and the Jornada Basin Long Term Ecological Research program. He will develop and teach dryland ecology courses for both undergraduates and graduates in the PES Department.

- Grant Updates

- Clovis: Simulating SOC in a Wheat-Fallow System Using the Daycent Model (Rajan Ghmiri)

- Farmington: Poplar Phytoremediation Study at an Abandoned Oil Refinery Site in Northwestern (Kevin Lombard)

- WSARE Professional Development Program: Developing Digital Tools to Improve Soil Sampling and Analysis for Sustainable Agriculture in the Western U.S. (Robert Flynn, Troy Bauder, Joan Davenport, Jim Walworth, April Ulery, Jeanne Gleason, Barbara Hunter, Tomilee Turner)

- Plant & Environmental Sciences: Evaluation of Source Water, Extraction Potential, and Potential Impacts of Using Brackish Water for Desalination in New Mexico. Kenneth Carrol.

Theses:

- Evaluation of Organic Fertilizers on the Growth and Yield of New Mexico Green Chile (*Capsicum annuum* L.) / by Laura Johnson.

- Assessment of water table and water quality variations with respect to river flow along the Rio Grande between Garfield and Canutillo, New Mexico / by Benjamin Nana O. Kuffour.

- Assessment of spatiotemporal groundwater level changes throughout New Mexico / by Spencer E. Willman.

Research Publications

- Singh, Sukhbir, Sangamesh V. Angadi, Kulbhushan Grover, Sultan Begna, Dick Auld. 2016. New Drought response and yield formation of spring safflower under different water regimes in the semiarid Southern High Plains. Agriculture Water Management 163:354-362

- Baath, Gurjinder S.; Manoj K. Shukla; Paul W. Bosland; Robert L. Steiner; Stephanie J. Walker. 2016. Irrigation water salinity influences at various growth stages of *Capsicum annuum*. Agricultural Water Management. Agricultural Water Management 179:246-253.

- Harmandeep Sharma, Manoj K. Shukla, Paul W. Bosland, Robert Steiner. 2017. Soil moisture sensor calibration, actual evapotranspiration, and crop coefficients for drip irrigated greenhouse chile. Agricultural Water Management, 179:81-91.

Extension Guides

- Guide H-707: Landscape Water Conservation: Principles of Xeriscape, Revised by Bernd Leinauer (Extension Turfgrass Specialist, Dept. of Extension Plant Sciences)

- Guide M-112: Water Quality for Livestock and Poultry (Revised). Rossana Sallenave (Extension Aquatic Ecology Specialist, Dept. of Extension Animal Sciences and Natural Resources)

- Guide H-509: Turfgrass Establishment. Revised by Bernd Leinauer (Extension Turfgrass Specialist, Dept. of Extension Plant Sci.)

- Guide H-110: Backyard Composting. Revised by John Allen (County Program Director, Hidalgo County Extension Office)

- Guide H-508: Turfgrasses for New Mexico. Bernd Leinauer (Extension Turfgrass Specialist, Dept. of Extension Plant Sciences)

- Guide H-164: Vermicomposting. Revised by John Allen (County Program Director, Hidalgo County Extension Office)

- Guide H-258: Field Production of Organic Chile. By Charles Havlik (Senior Research Assistant, Ag. Sci. Center at Los Lunas), Kulbhushan Grover (Associate Professor, Dept. of Extension Plant Sciences), Paul W. Bosland (Regents Professor, Dept. of Plant and Environmental Sciences), and Stephanie J. Walker (Extension Vegetable Specialist, Dept. of Extension Plant Sciences).

OREGON WERA-103 report

Oregon State University

OSU Welcomes new WERA 103 Partners

The Department of Crop and Soil Science at Oregon State University is happy to welcome these partners in nutrient management:

- Shannon Andrews is the new manager of the Central Analytical Laboratory in the Department of Crop and Soil Science at Oregon State University. She is a candidate for the PhD in soil science, focused on efficient use of nutrients supplied by organic fertilizers. The Department has invested in CAL to make it a center piece of the educational program at OSU. Students across the university whose studies intersect with soil science are trained in general soil laboratory analysis and consultation. CAL is working with the NRCS and local SWCDs to develop a soil health database and assess meaningful metrics to measure soil health.

- Maziar M. Kandelous is Assistant Professor and Extension Soil Water Quality Specialist in the Department of Crop and Soil Science on the Corvallis campus of Oregon State University. He has a PhD in Hydrologic Science from UC Davis and was trained in Irrigation and Drainage Engineering at the University of Tehran, Iran. His primary research goal is to elucidate the interactions among atmosphere, plant, soil, water, and solutes as they contribute to sustainable agricultural practices in the context of water quality.

- Ruijun (Ray) Qin is Assistant Professor and Agronomist in the Department of Crop and Soil Science at Oregon State, housed at the Hermiston Agricultural Research & Extension Center in Hermiston OR. He comes to us from USDA-ARS and UC Davis where he collaborated with growers, regulators, and universities on best fumigant use practices, soil and air quality, water and nutrient management, and high-value crops (strawberry, grape, almond, and vegetable). Currently, his extension and research programs focus on field crop agronomy and soil-nutrient- and water management in high-value irrigated crops, reuse of wastewater and by-products from local processing plants, and environmental quality and soil health.

Ongoing research, Vegetable and field crops

Providing organic nutrient management guidance to processed vegetable growers. Sullivan, Heinrich, and Peachey

Using an in-field aerobic soil incubation technique at constant moisture, average “background” soil N mineralization at 12-wks from six organic and one transitional field was 103 lb N/acre-8 inches (range 60 to 161). This represented a rate of 1.2 lb N/acre-8 inches/day (range 0.9 to 1.9), and 2.1% of total soil N (range 1.1 to 3.3). Based on N mineralization results and in-field monitoring of five sites growing organic sweet corn, three had adequate N nutrient management programs, and two exceeded crop N needs. The fields with high N had a history of raw chicken litter applications.

Ongoing research, berry crops

Bernadine Strik continues to research nutrient management in blueberry, particularly in organic production systems. An on-going project is focused on the impact to soil and plant nutrient status and yield of 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 10 blueberry cultivars in an organic system, but pre-plant amendment with a farm compost (high in Ca) increased soil pH so much so that some cultivars had reduced yield. A Ph.D. student working with Strik (Fernandez-Salvador) is studying the impact of organic mulch type (weed mat & sawdust), cultivar (Duke, Liberty) and fertilizer source (fish, feather meal) on nutrient content and allocation in mature organic blueberry. Recent work has shown that blackberry leaf nutrient levels vary through the season by blackberry type (trailing, erect, and semi-erect) and cultivar. The recommended range for tissue sampling has been extended. A M.S. graduate student (Kingston) working with Scagel, Bryla and Strik has studied the impact of media components and potassium source and rate on the growth of blueberry in containers; substrate production of blueberry is an emerging trend in many production areas worldwide. Many publications are available on Strik's horticulture department web site.

Dr. David Bryla (USDA-ARS, Horticultural Crops Research Unit, Corvallis, OR) continues to conduct research on nutrient management of berry crops in both organic and conventional systems. His current projects include irrigation practices to maximize nutrient use efficiency; fertigation with liquid P, K, and micronutrient fertilizers; nutrient management in containerized systems; and exploring the potential benefits of supplementing fertilizer programs with composts, humic acids, and biochar. Links to his previous publications are available online at https://www.ars.usda.gov/pacific-west-area/corvallis-or/horticultural-crops-research/people/david-bryla/.

Publications

Research

- Anderson, N.P., T.G. Chastain and C.J. Garbacik. 2016. Enhancing fertilizer efficiency in perennial ryegrass seed crops with urease inhibitors. In N. Anderson, A. Hulting, D. Walenta, M. Flowers, and C. Sullivan (ed.) Seed Production Research. Crop Sci. Ext. Rep. 152:12-14.

- Barcelos, C., Machado, R.M., Alves-Pereira, I., Ferreira, R., Bryla, D.R. 2016. Effects of substrate type on plant growth and nitrogen and nitrate concentration in spinach. International Journal of Plant Biology. 7:44-47.

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Extension publications

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- Heinrich, Aaron, Alex Stone, Dan M. Sullivan, James Myers, Ed Peachey. 2016. Integrated Clubroot Control Strategies of Brassicas: Nonchemical Control Strategies. EM 9148. Oregon State University Extension Service, Corvallis, OR.

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- Kaiser, C., Horneck, D., Koenig, R., Porter, L., Brewer, L. (2016). Green Pea Nutrient Management Inland Northwest — east of the Cascades (vol. EM 9140, pp. 4). Corvallis, OR: Oregon State University Extension Service. https://catalog.extension.oregonstate.edu/sites/catalog.extension.oregonstate.edu/files/project/pdf/em9140.pdf

- Lutcher, L. K., Sullivan, C., Flowers, M. D., Mundt, C. C., Wysocki, D. J., Rhinhart, K. E. L., Marshall, J. M. (2016). *Performance of Hard Red Winter Wheat in Late-Planted Fallow*. PNW 645. https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw635_3.pdf

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Proceedings/Webinars/Abstracts/Other publications

- Arispe, S. A., Estill, C., Downing, T. W. (2016). *Veterinary Feed Directive: Questions and Answers for Oregon Livestock Producers* (vol. July/August). Oregon Beef Producer/Oregon Cattlemen's Association.

- Bohle, M. G., Gerth, W. J., Hulting, A., Sullivan, D. M., Hannaway, D. B., Horneck, D. (2016). *Organic Alfalfa Fertility Trials in Central Oregon* (pp. 4).

- Bohle, Mylen G. 2016. *Organic Alfalfa Fertility Trials in Central Oregon*. Proceedings of the 2016 Idaho Hay Conference Proceedings. 4 pages.

- Kaiser, Clive. 2016. *Effects of three different rates of nitrogen fertilizer on season variations of leaf mineral concentrations of 'Summerred' apple trees in a Nordic Climate*. VIII International Symposium on Mineral Nutrition of Fruit Crops, International Society for Horticultural Sciences. October, 2016. Antalya, Turkey.

- Shewmaker, G., Bohle, M. G., Fransen, S. (2016). *Pasture and Grazing Management Extension Programing in Northwestern USA* (pp. 589-590). Saskatoon, SK: 10th International Rangeland Congress. http://2016canada.rangelandcongress.org.

- Wilson, Tracy M. 2016. *Nitrogen Management for Carrot Seed Production*. Presented at ASA-CSSA-SSSA International Annual Meeting. Phoenix, AZ. 9 November.

- Wysocki, Donald J. 2016. *Brassica Nutrition: Fine Tuning Your Nutrient Bill. Washington State University Oilseed Workshop*. Dayton WA. January 2016. wysockid/present/Dayton Canola 2016-1.pdf.

UTAH WERA-103 report

Grant Cardon (USU) and Bryan Hopkins (BYU) and noted colleagues

Utah State University

Two projects of focus in soil fertility management conducted under objective 1 of the WERA-103 project were both directed at updating and refining fertility recommendations in Utah and similar Intermountain West conditions.

- Nitrogen requirements for rotational crops following alfalfa (Grant Cardon and Earl Creech)

The primary crop in Utah continues to be alfalfa (80% + of cropped area). Educational efforts in the state guiding alfalfa productivity and quality management encourage higher frequency rotation, bringing greater focus on N management in rotational crops such as corn and small grains. Nitrogen credit for an antecedent alfalfa crop has long stood at 100 lbs N/ac in the first year only following alfalfa. However, preliminary studies on rotational crop performance indicated that the N credit may be much higher, potentially saving growers millions of dollars annually in unnecessary fertilizer inputs. The project now has collected data from 17 site years over four growing seasons for first year corn silage following alfalfa, 9 site years over two growing seasons for second year silage following alfalfa, and from seven different counties across Utah. Based on the results, it is clearly possible to reduce the N requirement as much as 200 units of N per acre (based on typical grower practice and USU recommendation levels) without yield reduction. USU will be adjusting recommendations accordingly and are projected to save Utah corn growers up to $10 million annually.

- Phosphorus management in eroded, highly calcareous dryland grain and safflower production

Throughout Utah and the great basin region, foothill and bench soils are often eroded by wind, mechanical soil movement, and water exposing highly calcareous subsoils. These soils present significant difficulty in maintaining sufficient P levels for adequate crop growth due to surface complexation and calcium phosphate precipitation. Phosphorous availability is exacerbated by the dryland growing conditions limiting P solubilization. A new project has been started in northern Utah to evaluate new and emerging P fertilizer technologies designed to prolong P availability, ostensibly providing benefit in these calcareous soils, but which have not been sufficiently evaluated in Utah.

Brigham Young University

Primary project areas:

- N use efficiency and yield effects of potato following alfalfa-based rotations
- Use and management of polymer-coated Urea. Areas of focus:
    - Turfgrass (rate-response and application timing)
    - Potato production
    - Atmospheric N losses
    - N release as a function of soil placement

- Ion-exchange resin capsule evaluation:
    - Placement effects on results
    - Comparison with traditional soil extraction methods
    - Effectiveness for evaluating N, P and S bio-availability

Publications:

Peer Reviewed Journal and Extension Publications:

- Hunter, B., G.E. Cardon, S. Olsen, D.G. Alston and D. McAvoy. 2016. Preliminary screening of the effect of biochar properties and soil incorporation rate on lettuce growth to guide research and educate the public through Extension. J. Agric. Ext. and Rural Devel. Vol.9(1), pp. 1-4, January 2017. DOI: 10.5897/JAERD2016. 0787

- Maughan, Tiffany, Grant Cardon and Brent Black. 2016. Calculating Fertilizer for Small Areas. USU Extension Publication. Horticulture/Fertilizers/2016-01.

- Maughan, Tiffany, Grant Cardon and Brent Black. 2016. Calculating Fertilizer for Small Areas – Excel Workbook. USU Extension Publication. All Current Publications. Paper 1582. http://digitalcommons.usu.edu/extension_curall/1582

- Thomsen, Esther, Diane Alston, Jennifer Reeve, Grant Cardon and Brent Black. 2016. Improving Organic Peach Orchard Fertility with Nitrogen-Fixing Ground Covers in Capitol Reef National Park: A Case Study. USU Extension Publication. Horticulture/Fruit/2016-04.

In Press:

- Buck, R.L., B.G. Hopkins, B.L. Webb, and V.D. Jolley. 2016. Depth of ion exchange resin capsule placement impacts on estimation of nitrogen, phosphorus, and sulfur bioavailability in semi-arid, low fertility soils. *Soil Sci.* 181: 216–221 DOI:10.1097/SS.0000000000000165

- Buck, R.L., B.L. Webb, V.D. Jolley, B. Roundy, and B.G. Hopkins. 2016. Comparing traditional soil extraction with ion exchange resin capsules for determining sulfur bioavailability in semiarid, low-fertility soils. *Soil Sci.* 181: 39-43. DOI:10.1097/SS.0000000000000137

- Jones, C.D., M.R. Stevens, V.D. Jolley, B.G. Hopkins, S.L. Jensen, D. Turner, and J.M. Stettler. 2016. Evaluation of thermal, chemical, and mechanical seed scarification methods for four Great Basin Lupine species. *Native Plants Journal.* 1: 5-18 DOI:10.3368/npj.17.1.5

- Katseanes, C.K., M.A. Chappell, B.G. Hopkins, B.D. Durham, C.L. Price, B.E. Porter, and L.F. Miller. 2016. Multivariate functions for predicting the sorption of 2,4,6-trinitrotoluene (TNT) and 1,3,5-trinitro-1,3,5-tricyclohexane (RDX) among taxonomically distinct soils. *J. Environ. Manage.* 182: 101–110. DOI:org/10.1016/j.jenvman.2016.07.043

- LeMonte, J.J., V.D. Jolley, J.S. Summerhays, R.E. Terry, and B.G. Hopkins. 2016. Polymer coated urea in turfgrass maintains vigor and mitigates nitrogen's environmental impacts. *Plos one* 11: e0146761. DOI:10.1371/journal.pone.0146761

Conference Proceedings:

- Hopkins, B.G. 2016. Polymer Coated Urea: Mitigating Nitrogen Loss to the Environment. International Nitrogen Initiative Conference. Melbourne, Australia. Dec. 4, 2016. Available at: www.ini2016.com/pdf-papers/INI2016_Hopkins_Bryan.pdf

- Professional Meetings with Abstracts:

- Bartholomew, S., J. Buss, N. C. Hansen, and B. G. Hopkins. 2016. Polymer coated urea in Kentucky bluegrass. *In* Abstracts, 14th Annual Nitrogen Use Efficiency (NUE) Conference; 2016 Aug. 8-10; Boise, ID. Moscow, ID: University of Idaho.

- Bartholomew, S., K. Russell, N.C. Hansen, and B.G. Hopkins. 2016. Syringing Kentucky bluegrass: frequency impacts canopy temperature and growth. *In* Abstracts, ASA•CSSA•SSSA International Annual Meetings; 2016 Nov. 6-9; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

- Campbell, C. S., N.C. Hansen, B.G. Hopkins, S.R Evans, L.D. Rivera, D.R. Cobos, and G.S. Campbell. 2016. In situ moisture release curves to determine soil water characteristics. *In* Abstracts, ASA•CSSA•SSSA International Annual Meetings; 2016 Nov. 6-9; Phoenix, AZ. ASA-CSA-SSSA, Madison, WI.

- Cooper, R.L., J.D. Williams, and B.G. Hopkins. 2016. Effects of Mosaic Aspire compared with MOP and boron blended fertilizer on alfalfa yield and quality. *In* Abstracts, ASA•CSSA•SSSA International Annual Meetings; 2016 Nov. 6-9; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

- Evans, S.R., C.S. Campbell, B.G. Hopkins, and N.C. Hansen. 2016. The effects of water use in turfgrass using sensor-driven decisions. *In* Abstracts, ASA•CSSA•SSSA International Annual Meetings; 2016 Nov. 6-9; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

- Harding, C., J.D. Williams, and B.G. Hopkins. 2016. Comparison of ESN and urea on potato petiole nitrate and yield in southeast Idaho. *In* Abstracts, ASA•CSSA•SSSA International Annual Meetings; 2016 Nov. 6-9; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

WASHINGTON WERA-103 report

Washington State University

Ongoing Research

- (Davenport and Granastein) Monitoring uptake of legume N by apple trees using N isotopic discrimiation. Funded by Washington State University's BIOAg Initiative. Comparing 15N labeled N from urea and legumes with non labeled legume for N uptake into apple trees after spring (May) and fall (August) applied materials.

- (Davenport and T. Sullivan) Microbial and Photo Siderophores for Alleviating Concord Chlorosis. Funded by Washington State Concord Grape Research Council. Study of soil microbiome in chlorotic and nonchlorotic Concord grape. Also evaluating the impact of grass cover crops on chlorosis and Fe bioavailability.

- (Davenport and L. Devetter) Blueberry Tissue Nutrient Standards for Eastern Washington. Funded by Washington State Blueberry Commission. Leaf tissue sampling throughout the growing season on early, mid, and later season cultivars to determine what nutrient standard ranges should be as well as to evaluate optimal sampling time.

- (Davenport) Compost Applications on Golf Course Fairways. Funded by Joint Base Lewis McChord and the NW Turf Association. Ph. D. student Nathan Stacey is evaluating compost as an alternative to N fertilizers for golf course fairways.

Research publiations

- Chi, J., S. Waldo, S.Pressley, P. O'Keeffe, D. Huggins, C. Stöckle, W. L. Pan, E. Brook, and B. Lamb. 2016. Assessing carbon and water dynamics of no-till and conventional tillage cropping systems in the inland Pacific Northwest US using the eddy covariance method. Agricultural and Forest Meteorology 218–219 (2016) 37–49

- Keller, M., P. M. Shresthra, G. E. Hall, B. R. Bondada, and J. R. Davenport. 2016. Arrested sugar accumulation and altered organic acid metabolism in grape berries affected by the berry shrivel syndrome. AJEV 67: 398 - 406. DOI: 10.5344/ajev.2016.16048

- Long, D., F. Young, W. Schillinger, C. Reardon, J. Williams, B. Allen, W. Pan, D. Wysocki. 2016. Ongoing development of dryland oilseed production systems in northwestern region of the United States. Bionenergy 9:412-429. DOI 10.1007/s12155-016-9719-1.

- Maaz, T., W.L. Pan and A.H. Hammac. 2016. Influence of soil nitrogen and water supply on canola nitrogen use efficiency of canola. Agronomy Journal 108: 2099-2109.

- Pan, W.L. I.J. Madsen, L. Graves, T. Sistrunk, R. Bolton. 2016. Ammonia/ammonium toxicity of root meristems and root hairs as influenced by inorganic and organic fertilizer sources and placement. Agronomy Journal 108: 2485-2492.

- Pan, W.L., T. M. Maaz, W.A. Hammac, V.A. McCracken, R.T. Koenig. 2016. Mitscherlich-modeled, semi-arid canola nitrogen requirements influenced by soil N and water. Agronomy Journal 108: 884-894.

- Pan, W.L., FL Young, T.M. Maaz,D. R. Huggins,. 2016. Canola Integration into semi-arid wheat cropping systems of the inland Pacific Northwestern USA. Crop and Pasture Science 67(4) 253-265

- Waldo, S. J. Chi, S. Pressley, P. O'Keeffe, W.L. Pan, E. Brooks, D. Huggins, C. Stockle, and B. Lamb. 2016. Assessing carbon dynamics at high and low rainfall agricultural sites in the inland Pacific Northwest US using the eddy covariance method. Agricultural and Forest Meteorology 218–219 (2016) 25–36.

Extension publications

- Beard, T., K. Sowers, and W. Pan. 2016. Physiology Matters: Adjusting Wheat-based Management Strategies for Oilseed Production (Oilseed Series). FS244E Washington State University Extension.

- Davenport, J. R. 2016. Soils for producing premium grapes (Video Publication). In Moyer, M.M. and G.A. Hoheisel (eds). Vine to Wine: Successfully Establishing a Vineyard and Winery. WSU Extension Publication OM41. Washington State University. http://pubs.wpdev.cahnrs.wsu.edu/pubs/om41/#soils

- Davenport, J. R. 2016. Nutrient management for new and existing vineyards (Video Publication). In Moyer, M.M. and G.A. Hoheisel (eds). Vine to Wine: Successfully Establishing a Vineyard and Winery. WSU Extension Publication OM41. Washington State University. http://pubs.wpdev.cahnrs.wsu.edu/pubs/om41/

- Hoheisel, G., Moyer, M.M., Daniels, C.H., Miller, T.W., Walsh, D., Zasada, I., Rayapati, N.A., and Davenport, J.R. (2016). 2016 Pest Management Guide for Grapes in Washington. 2016 Pest Management Guide for Grapes in Washington

Published Abstracts, Presentations

- Hammac, W.A., W.L. Pan, R.T. Koenig, A. Fortuna, B.K. Lamb, J.P. Reginald. 2016, Cropping system, agroecological zone, and nitrogen use efficiency effect on greenhouse gas mitigation for biodiesel feedstock production" (MS #1118). AgroEnviron 2016: 10th International Symposium on Agriculture and the Environment - May 23-27, 2016, Purdue University, W. Lafayette, IN.

- Maaz T.M., D.J. Brown, D. R. Huggins, E. Brooks, J. U.H. Eite, K. A. Sanguinet, Lee A Vierling. and W. L. Pan. 2016. Managing Chlorosis in Waterlogged, Dryland Winter Wheat. ASA, CSSA and SSSA International Annual Meetings, Phoenix, AZ.

- Maaz T.M., W. L. Pan. 2016, Rotational Nitrogen Use Efficiency: Beyond Single Season Estimates. ASA, CSSA and SSSA International Annual Meetings, Phoenix, AZ.

- Maaz T.M., W.L. Pan. 2016. Overwinter Nitrogen Cycling in Winter Canola. ASA, CSSA and SSSA International Annual Meetings, Phoenix, AZHammac, W.A., W.L. Pan, R.T. Koenig, A. Fortuna, B.K. Lamb, J.P. Reginald. 2016, Cropping system, agroecological zone, and nitrogen use efficiency effect on greenhouse gas mitigation for biodiesel feedstock production" (MS #1118). AgroEnviron 2016: 10th International Symposium on Agriculture and the Environment - May 23-27, 2016, Purdue University, W. Lafayette, IN.

- Madsen, I.J. and W.L. Pan. 2016. Canola Seedling Root Damage Caused by Ammonium Fertilizers. *In* 2016 Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech Report 16-1, WSU, Pullman, WA.

- McCracken, V. and J. Connolly. 2016. Cropping Systems: Economic Returns to Canola Rotations in Eastern Washington. *In* 2016 Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech Report 16-1, WSU, Pullman, WA.

- Pan, W.L., T.M. Maaz, W.A. Hammac, V.A. McCracken, and R.T. Koenig. 2016. Semi-Arid Canola Nitrogen and Water Requirements. *In* 2016 Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech Report 16-1, WSU, Pullman, WA.

- Pan, W., M. Reese, T. Beard, I. Madsen, and T. Maaz. 2016. Subsoil Quality: Do our subsoils provide wheat and canola roots with ample water and nutrients during grain filling? *In* 2016 Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech Report 16-1, WSU, Pullman, WA.

- Pan, W.L., F.L. Young, T.M. Maaz, and D.R. Huggins. 2016. Canola-Wheat Integration in the Inland Pacific Northwestern U.S. *In* 2016 Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech Report 16-1, WSU, Pullman, WA.

- Ramphisa, P.D., Jones, C.A., Davenport, J. 2016. Corn response to conventional versus alternative phosphorus fertilizer sources in five different soils. Poster presented at: Resilience emerging from scarcity and abundance. ASA, CSSA, SSSA Annual Meetings, Phoenix AZ. 6-9 Nov. Poster 478-428.

- Sowers, K., D. Roe, B. Pan, F. Young, A. Esser, and B. Schillinger. 2016. Extension and outreach: Getting oilseed information in the hands of stakeholders. p. 32-33. *In* Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech. Report 16-1, WSU, Pullman, WA.

- Stacey, N., Davenport, J., Stahnke, G. 2016. Compost as nutrient substitute for golf course fairways. Oral presentation at: Resilience emerging from scarcity and abundance. ASA, CSSA, SSSA Annual Meetings, Phoenix AZ. 6-9 Nov. Oral 198-7.

- Young, F., L. Port, and W. Pan. 2016. Best Management Practices to Improve Low Rainfall Oilseed Production. *In* 2016 Dryland Field Day Abstracts: Highlights of Research Progress. Dept. of Crop and Soil Sciences Tech Report 16-1, WSU, Pullman, WA.

WYOMING WERA-103 report

University of Wyoming, Jay Norton, Associate Professor and Soil Fertility Specialist, Department of Ecosystem Science & Mnmgt; Urszula Norton, Associate Professor of Agroecology, Department of Plant Sciences

Current Grant-Funded Projects

- 2014-18: Compost carryover and cover crop effects on soil quality, profitability, and cultivar selection in organic dryland wheat. USDA-OREI in collaboration with Utah State, $1,555,000 total; $305,000 UW subaward.

- 2014-16: Soil Organic Matter, Water Use, and Crop Response to N and P in Sugarbeet-Bean-Barley Rotations under Conservation Tillage, Cover Crops, and Limited Irrigation. UW Ag Exp. Station Competitive Grant Program, $75,000.

- 2014-16: Soil Health, Water Use, and Fertilizer Recommendations for Sugarbeet-Dry Bean- Barley Rotations under Conservation Tillage and Limited Irrigation, Wyoming Dept of Agriculture Ag Producer Priority Grant Program, and UW AES, $40,000.

- 2015-2016: Mechanisms linking ecosystem N processing and hydrological transport following bark beetle-caused forest mortality: Urszula Norton and Jay Norton, UW EPSCOR, $33,200

- 2015-2017: Riparian Wetland Soil Quality as Affected by Grazing Exclusion: Sweetwater Wetland Study. USDI-BLM, $6000.

- 2016-2017: Harnessing the Sun to Produce Fertilizer On-farm: Jay Norton and Jessica Davis, Wyoming Specialty Crop Grant, $24,500.

- 2017-2018: Sustainable Production Practices for Edible Dry Beans: Jay Norton, Jim Heitholt, Urszula Norton, others, Wyoming Specialty Crop Grant, $24,500.

- 2017-2018: Edible dry beans as part of improved crop rotations in Wyoming: Jay Norton, Jim Heitholt, Wyoming Bean Commission, $5000.

- 2015-2018Best Cover Crop and Tillage Management Strategies for Dryland Winter Wheat Cropping Systems in Central High Plains. Urszula Norton and Jay Norton. Wyoming Department of Agriculture, $20,000.

Research Publications

- Okeyo J, J Norton, S Koala, B Waswa, J Kihara, A Bationo. 2016. Impact of reduced tillage and crop residue management on soil properties and crop yields in a long-term trial in western Kenya. Soil Research 54: 719-129. 2016.

- Aboukila EF, IN Nassar, M Rashad, M Hafez, JB Norton. 2016. Reclamation of calcareous soil and improvement of squash growth using brewers' spent grain and compost. Journal of the Saudi Society of Agricultural Sciences 2016.

- Lamb JN, KM Moore, J Norton, EC Omondi, R Laker-Ojok, DN Sikuku, DS Ashilenje, J Odera. 2016. A social networks approach for strengthening participation in technology innovation: lessons learnt from the Mount Elgon region of Kenya and Uganda. International Journal of Agricultural Sustainability 14 (1), 65-81 2016.

- Hurisso TT, U Norton, JB Norton, J Odhiambo, SJ Del Grosso, GW Hergert, DJ Lyon. 2016. Dryland soil greenhouse gases and yield-scaled emissions in no-till and organic winter wheat–fallow systems. Soil Science Society of America Journal 80 (1), 178-192. 2016.

- Ghimire R, U Norton, P Bista, AK Obour, JB Norton. 2017. Soil organic matter, greenhouse gases and net global warming potential of irrigated conventional, reduced-tillage and organic cropping systems. Nutrient Cycling in Agroecosystems 107: 49–62. 2016.

- Ghimire R, U Norton, P Bista, AK Obour, JB Norton. 2017. Soil organic matter, greenhouse gases and net global warming potential of irrigated conventional, reduced-tillage and organic cropping systems. Nutrient Cycling in Agroecosystems 107: 49–62. 2016.

- Norton, U., J. Odhiambo, J. Norton. Conservation agriculture practices in smallholder farming of western Kenya: nutrient cycling and greenhouse gas fluxes. In review by co-authors. For submission to Nutrient Cycling in Agroecosystems. 2017.

Extension Publications, Proceedings, and Other Publications

- Rooney EC, M Badu, J Norton, U Norton, E Creech. 2016. Compost carryover and cover crop effects on soil quality and profitability in dryland wheat. Proceedings of the Great Plains Soil Fertility Conference, March 1-2, 2016, Denver. 2016.

- Rooney EC, JB Norton. 2016. Cover Crops and Compost Carryover Effects on Phosphorus Cycling in Calcareous Soils. Abstracts, Meeting of the American Society of Agronomy. November 7, 2016, Phoenix. 2016.

- Norton, JB, and OK Ng'etich. 2017. N and P rates for sugarbeet under sprinkler irrigation and conservation tillage. UW Ag Exp. Station Field Days Bulletin.

Workshops and Meetings hosted

- 3rd annual High Plains Organic Farming Conference, February 22-23, 2016, Cheyenne

- 4th annual High Plains Organic Farming Conference, February 21-22, 2017, Cheyenne

Presentations

- Rooney EC, JB Norton. 2016. Cover Crops and Compost Carryover Effects on Phosphorus Cycling in Calcareous Soils. American Society of Agronomy, November 7, 2016, Pheonix.

- Rooney EC, M Badu, J Norton, U Norton, E Creech. 2016. Compost carryover and cover crop effects on soil quality and profitability in dryland wheat. Great Plains Soil Fertility Conference, March 1-2, 2016, Denver.

- Urszula Norton; Judith Odhiambo; Jay Norton. 2016. Conservation Agriculture Practices in Smallholder Farming of Western Kenya: Nutrient Cycling and Greenhouse Gas Fluxes. Tropentag Conference on Tropical Agriculture, September 21, 2016, Vienna, Austria.

- Norton JB, U Norton, D Ashilenje. 2016. Conservation Agriculture in the Mt Elgon Highlands of Kenya and Uganda: Successes and Limitations. Tropentag Conference on Tropical Agriculture, September 21, 2016, Vienna.

- Urszula Norton; Prakriti Bista; Rajan Ghimire; Jay Norton. 2016. Greenhouse gas fluxes and global warming potential in three winter wheat systems during drought in eastern Wyoming, USA. International Conference on Agrophysics in Lublin, Poland, 28th September, 2016.

- Urszula Norton; Ada Harris; Susan Schmidt; Jay Norton. 2016. Terrestrial carbon and nitrogen eight years after large scale beetle-caused forest mortality. International Conference on Agrophysics, Lublin, Poland; September 28th, 2016.

- Norton JB. 2016. Wyoming soils and their reconstruction following extraction of energy resources. November 7, 2016, Wroclaw University of Environmental and Life Sciences, Institute of Soil Science and Environmental Protection, Wroclaw, Poland.

- Norton JB. 2016. Soil Health and Gardening Basics in Wyoming. Wyoming Gardening Conference, April 2, 2016, Riverton.

- Norton JB. 2016. Soil health and fertility for home gardens. Laramie Local Foods Conference, April 30, 2016, Laramie.

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