**WERA-103 2016 Report – Compiled State and Industry Submitted Reports**

ALP-MAP-CAP Proficiency Programs, SPAC

*Robert Miller, Colorado State University*

*Programs Coordinator* .

March 1, 2016

**ALP Program**

The Agricultural Laboratory Proficiency (ALP) program is the only accredited proficiency provider for agricultural lab testing in North America under ISO/IEC 17043 by ANAB. One hundred six laboratories were enrolled in the program as of February 2016, with new laboratory participants from California, Mid Atlantic region and Canada. New for 2016 is the expansion of the botanical program to include four proficiency samples per cycle to accommodate vegetable crops and US-EPA 503 metals. ALP has procured an inventory of 167 soils with 28 new collections in 2015 from: WA, OR, BC, SD, IA, WI, MI and ON. 2016 soil collections are planned for NM, CA and IL. A Greenhouse media/solutions proficiency program will launch in September 2016.

An ALP research project has completed assessing the effects of soil pulverizing on dry soil CO2 Solvita burst. Results show the issues associated with optimization of O2 and effects of texture. Results were presented at the Mid Atlantic Soil Workshop and Soil Health Institute meeting 2016.

ALP is a recognized proficiency provider: for NRCS 590 requirements in California Idaho and Illinois; the Minnesota Dept of Agriculture; and is the sole provider of proficiency data for the Illinois Soil Testing Association Laboratory Accreditation Program (ISTA-LAP). Twelve laboratory site visits were conducted during 2015. ALP has sponsored: the 2015 SERA-6 Meeting; SSSA Leo Walsh Award reception in November; 2015 and the 2016 Mid-Atlantic Soils Meeting. Work completed on the Modus soil/plant analysis method library.

**MAP and CAP Programs**

The Manure Analysis Proficiency (MAP) administered by the Minnesota Department of Agriculture (MDA) program has an enrollment of 74 labs enrolled. This is a required certification program 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 laboratories enrolled. Revisions have been completed on the USCC publication Test Methods for the Examination Composting and Compost, United States Compost Council (USCC) which has provided funding support, edited by Wayne Thompson of Washington State Univ.

**Soil and Plant Analysis Council Activities**

The 15th ISSPA meeting is schedule for May 14-19, 2017, in Nanjing, China in conjunction with ASPAC of Australia-New Zealand. SPAC now offers six sizes of soil testing scoops for Midwest soil testing labs, and will initiate a certified laboratory program in July 2016 for botanical analysis in North America.

**Research**

Midwest corn K fertility research continues with support from WinField Solutions, Climate Corp., Fluid Fertilizer Foundation, Nachurs and PCS. Summary results show optimum corn population at three of four locations was between 34,000 and 36,000 plts/ac. Results of side dress K applications had response at 5 of 8 sites for multiple K source materials.

**2016 Arizona WERA 103 report**

**Personnel Changes:**

Mr. Josh Sherman was hired as the new Southeastern Arizona Commercial Horticulture Cooperative Extension Agent with responsibilities in nut (pecan and pistachio) and wine grape production.

Dr. Jim Walworth became Associate Head of the Department of Soil, Water and Environmental Science.

**Ongoing Research:**

Assessing the Potential for Dust Emission “Hotspots” in the Sonoran Desert under Warmer, Drier Climate: Linking Soil Salinity and Sodicity to Biocrust Development and Dust Production. D. Breshears

Biocrusts, Grass Establishment, and Restoration of Working Rangelands. S. Archer

Breeding for Improved Nutrient Use Efficiency. C. Sanchez

Can Biological Soil Crusts Inhibit Germination or Establishment of Invasive Grasses in Southwestern Rangelands. S. Archer

Can the Yield of Late-Planted Small Grains be Compensated by Water and Nitrogen Rates? M. Ottman, R. Ward

Development and Evaluation of an Organic Hydroponic System for Greenhouse Vining Crop Production. S. Tollefson, G. Giacomelli

Development and Field Testing of Sensor-Based Algorithm for N-Fertillizer Management of AZ Durum Wheat. P. Andrade Sanchez

­­­­Development of Economically Viable Variable Rate P Application Protocols for Desert Vegetable Production Systems. C. Sanchez, K. Nolte, P. Andrade Sanchez

Development of Economically Viable Variable Rate P Application Protocols for Desert Vegetable Production Systems. C. Sanchez, K. Nolte, P. Andrade Sanchez

Effect of SAR and Micronutrients on Lemon Tree Health. G. Wright

Effects of Soil and Foliar Applications of Two Microbial Exudates on Production of Fresh-Market Tomato and Seedless Watermelon Grown Using Drip Irrigation. C. Sanchez

Evaluation of Cotton Yield, Quality, and Plant Growth Response to Soil-Applied Potassium. E. Norton, G. Morgan, B. Robertson, D. Fromme, A. Phillips, D. Dodds, M. Jones, T. Raper, H. Frame, J. Whitaker, S. Byrd, R. Nichols, K. Edimsten.

Evaluation of Nitrogen Fertility in Arizona Cotton Production Systems. E. Norton, K. Bronson

Expanded Sampling and Mitigation Strategy Evaluation for Cadmium in Desert Spinach. C. Sanchez, P. Brierley

Exploring the Potential of Transgenic Crops for Improved Fertilizer Use Efficiency. C. Sanchez

Field Evaluation and Demonstration of Controlled Release N Fertilizers in the Western United States. C. Sanchez

Identifying and Addressing Barriers to Implementing Organic Hydroponic Systems for Greenhouse Vining Crop Production. G. Giacomelli

Late Season N Application Method Effect on Grain Protein. M. Ottman, R. Ward

Mitigation of Heavy Metals in Produce. C. Sanchez

Nickel Nutrition of Arizona Pecans. J. Sherman, J. Walworth

Nitrogen Fertility Evaluations. E. Norton, K. Bronson

Nitrogen Fertilization for Arizona Pecan Orchards. J. Walworth

Phosphorus Requirements in Arizona Pecan Orchards. J. Walworth

Precision Canopy and Water Management of Specialty Crops through Sensor-Based Decision Making. P. Andrade Sanchez, T. Teegerstrom. E. Martin, J. Walworth, M. Kacira

Reclamation of Saline-Sodic Fairway Soils. P. Brown, J. Walworth

Spatial and Temporal N Management for Desert Vegetable Production System. C. Sanchez, P. Andrade Sanchez

**Publications:**

Archer, S. R., & McIntyre, C. (2015). Report: Biocrusts, grass establishment, and restoration of working rangelands: Annual Report. Western Sustainable Agricultural Research & Education Program.

Barnes, P. W., Throop, H. L., Archer, S. R., Breshears, D. D., McCulley, R. L., & Tobler, M. A. (2015). Sunlight and soil–litter mixing: Drivers of litter decomposition in drylands. Progress in Botany, 76, 273-302.

Bronson, K., Norton, E. R., Hunsaker, D., & Andrade Sanchez, P. (2015). Improving Nitrogen Fertilizer Management for Overhead Sprinkler-Irrigated Cotton in the Western US. In 2015 Beltwide Cotton Conference (pp. 403-410). San Antonio, TX: National Cotton Council.

Bronson, K., Norton, E. R., Hunsaker, D., & Lidell, E. (2015). Updating Petiole Nitrate-Based N Fertilizer Recommendations for Arizona Cotton. In 2015 Beltwide Cotton Conference (pp. 392-397). San Antonio, TX: National Cotton Council.

Burghelea, C., Zaharescu, D. G., Dontsova, K., Maier, R., Huxman, T., & Chorover, J. (2015). Mineral nutrient mobilization by plants from rock: influence of rock type and arbuscular mycorrhiza. Biogeochemistry, 124(1-3), 187-203.

Cendrero-Mateo, M. P., Moran, M. S., Papuga, S. A., Thorp, K. R., Alonso, L., Moreno, J., et al. (2015). Plant chlorophyll fluorescence: active and passive measurements at canopy and leaf scales with different nitrogen treatments. *Journal of Experimental Botany*, *67*(1), 275-286.

Faber, B., Walworth, J. L., Giraud, D. D., & Silva, D. (2015). Soil and Fertilizer Management. In California Master Gardener Handbook, Second Edition (pp. 37-82). Richmond, CA: University of California Agriculture and Natural Resources.

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 CO2 are age dependent. Field Crops Research, 185, 97-102.

Hafsteinsdottir, E. G., Rocavert, A. L., Camenzuli, D., Walworth, J. L., & Gore, D. B. (2015). Chemical immobilization of metals and metalloids by phosphates. Applied Geochemistry, 59, 47-62.

Heerema, R., & Walworth, J. L. (2015). 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.

Mostafa, A. M., Ottman, M. J., Jason, R., & Burayu, W. (2015). Research Report Phosphorus Fertilizer Rate Effect on Alfalfa Yield and Soil Test P, Buckeye, 2014. University of Arizona Cooperative of Extension Publications, AZ 1672. 10 p.

Ottman, M. J., & Thompson, T. L. (2015). Fertilizing small grains in Arizona. College of Agriculture and Life Sciences, University of Arizona, Tucson.

Ottman, M., Rovey, J., Mostafa, A., & Burayu, W. (2015). Phosphorus Fertilizer Rate Effect on Alfalfa Yield and Soil Test P, Buckeye, 2014. College of Agriculture and Life Sciences, University of Arizona, Tucson.

Root, R. A., Hayes, S. M., Hammond, C. M., Maier, R. M., & Chorover, J. (2015). Toxic metal(loid) speciation during weathering of iron sulfide mine tailings under semi-arid climate. Applied Geochemistry: Journal of the International Association of Geochemistry and Cosmochemistry, 62, 131-149.

Story, D. L., & Kacira, M. (2014). Design and Implementation of a Computer Vision Guided Greenhouse Crop Diagnostics System. Journal of Machine Vision and Applications.

Walworth, J. L. (2015). 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.

Walworth, J. L., Nunez-Moreno, H., & Pond, A. (2015). Soil Zinc Fertilization in One-Year-Old Potted 'Wichita' Pecan Trees in Alkaline Soil. In International Symposium on Pecans and Other Carya in Indigenous and Managed Systems. International Society for Horticultural Science.

­Wright, G. C. (2015). Citrus Fertilization Chart for Arizona. CALS Extension Publication #az1671. <http://extension.arizona.edu/pubs/citrus-fertilization-chart-arizona>

Wright, G. C. (2015). Evaluation of Nitrogen Fertilization Practices for Surface-Irrigated Lemon Trees – 2012. Commodity Research Report. <http://extension.arizona.edu/pubs/evaluation-nitrogen-fertilization-practices-surface-irrigated-lemon-trees-2012>

**2016 California WERA 103 report**

**T. K. Hartz**

**University of California**

**Status of nitrogen regulation in California agriculture**

State regulation of agricultural N use advanced during the past year, on several fronts. In the Central Coast Region, grower reporting of N fertilizer use and NO3-N in irrigation water began in 2014, for the first time putting geo-referenced, grower-specific N loading data in the hands of a regulatory agency. Following that lead, the Central Valley Water Board has recently modified its proposed N reporting scheme to require grower-specific N loading and irrigation data. 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. Based on California legislation to minimize greenhouse gas emissions, the Air Resources Board is also supporting study into N2O emission from agriculture, a precursor to regulation of irrigation and N fertility management.

 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 >600 CCAs. This training program will continue to be offered for several more years.

Additionally, the industry has developed and delivered a grower self-certification course on N management, to allow growers to sign off on their own farm management plans. Although the curriculum for this course was developed from existing UC training materials, the delivery of the course has been handled entirely by the grower Water Quality Coalitions active throughout the Central Valley region. To date, hundreds of growers have attended this course, and passed the self-certification exam.

**Ongoing research**

The CDFA Fertilizer Research and Education Program (FREP) continues to fund research on efficient nutrient management in a range of crops. Among ongoing FREP-sponsored projects are:

* Online Fertilization Guidelines for Agricultural Crops in California
* Development of a new Fertigation handbook
* Expansion of the CropManage on-line decision support tool to include processing tomato irrigation and fertilization recommendations
* Quantifying N2O Emissions under Different On-farm Irrigation and Nutrient Management BMPs that Reduce Groundwater Nitrate Loading and Applied Water
* 2015 Demonstration of a combined new leaf sampling technique for nitrogen analysis and nitrogen applications approach in almonds
* Evaluation of the Multiple Benefits of Nitrogen Management Practices in Walnuts
* Train the Trainer: A Nitrogen Management Training Program for Growers
* Developing Nitrogen Management Strategies to Optimize Grain Yield and Protein Content while Minimizing Leaching Losses in California Wheat
* Characterizing N Fertilization Requirements of Crops Following Alfalfa

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 in 2015**

Castro Bustamante, S. and T.K. Hartz. 2015. Nitrogen management in organic processing tomato production: nitrogen sufficiency prediction through early-season soil and plant monitoring. HortScience 50:1055-1063.

Espe, M.B., E. Kirk, C. VanKessel, W.H. Horwath and B.A. Linquist. 2015. Indigenous nitrogen supply of rice is predicted by soil organic carbon. Soil Sci. Soc. Amer. J. 79:569-576.

Harter, T. 2015. California’s agricultural regions gear up to actively manage groundwater use and protection. California Agriculture 69:193-201.

Kirk, E.R., C. VanKessel, W.R. Horwath and B.A. Linquist. 2015. Estimating annual soil carbon loss in agricultural peatland soils using a nitrogen budget approach. Plos One 10(3): e0121432.

Lazcano, C., J. Wade, W.R. Horwath and M. Burger. 2015. Soil sampling protocol reliably estimates preplant NO3- in SDI tomatoes. California Agriculture 69:222-229.

Lundy, M.E., Pittelkow, C.M., Linquist, B.A., Liang, X., van Groenigen, K.J., Lee, J., Six, J., Venterea, R.T., van Kessel, C. (2015). "Nitrogen fertilization reduces yield declines following no-till adoption." Field Crops Research 183: 204-210.

Martinez, H.E.P., A. Olivos, P.H. Brown, J.M. Clemente, C.H. Bruckner and J.L. Jifon. 2015. Short-term water stress affects NO3- absorption by almond plants. Sci. Hort. 197:50-56.

Muhammad, S., B.L. Sanden, B.D. Lampinen, S. Saa, M.I. Siddiqui, D.R. Smart, A. Olivos, K.A. Shackel, T. DeJong and P.H. Brown. 2015. Seasonal changes in nutrient content and concentrations in a mature deciduous tree species: studies in almond (*Prunus dulcis* (Mill.) D.A. Webb). European J. Agron. 65:52-68.

Zhu-Barker X., Horwath W.R., Burger M. 2015. Knife-injected anhydrous ammonia increases yield-scaled N2O emissions compared to broadcast or band-applied ammonium sulfate in wheat. Agriculture, Ecosystems and Environment, 212:148-157.

**Conference Proceedings**

23rd Annual Fertilizer Research and Education Program Conference Proceedings. California Dept. of Food & Agriculture. November 5-6, 2014. Seaside, CA. 86 pages. <https://www.cdfa.ca.gov/is/ffldrs/frep/pdfs/2015_Proceedings_FREP.pdf>

California Plant and Soil Conference, 2015 Conference Proceedings, Feb. 4-5, Fresno, CA. 169 pages. California Chapter American Society of Agronomy. <http://calasa.ucdavis.edu/files/208317.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 Farm Advisor 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/>

**WERA 103 Report- Colorado State University – 2015 Activities**

**Personnel changes**

**Dr. Steven Fonte** was hired to replace Jack Fenwick in Agroecology in the Dept. of Soil and Crop Sciences.

**Dr. Kenneth Barbarick** is serving as Associate Dean of Academic Programs

**Blake Osborn** was hired as Extension Specialist in Water Resources for Southern Colorado

**Projects:**

**Bridging the gap between wide-area assessment and farm level conservation planning: Demonstration in priority Colorado watersheds;** Mazdak Arabi;

**Objectives**:

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

**Enhanced Resource Recovery from a Multi-Stage Anaerobic Digester by Solids Composting**: S. Sharvelle;

**Objectives**:

The objective of this work is to determine the best approach for composting solids remaining after anaerobic digestion of manure in a multi-stage anaerobic digester to ensure complete resource recovery. Funds received from AES will be applied to test different approaches for composting solids products from mobile MSAD. Design recommendations will be provided for economic recovery of nutrients through solids composting. Contact: Sybil.Sharvelle@colostate.edu

**Impact of Corn Residue Removal on Soil Characteristics and Crop Production;** Joel Schneekloth; Contact: joel.schneekloth@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

**Long-term N effects on irrigated Sunflower-Corn rotations;** Kevin Larson;

**Objectives:**

To study the long-term N fertilizer effects on irrigated Sunflower-Corn and Corn-Corn (continuous corn) rotations where N rate are applied to the same treatment site for multiple years.

**Long-term N effects on Wheat-Sunflower-Fallow rotation;** Kevin Larson;

**Objectives**:

To study the long-term N fertilizer effects on a wheat-sunflower-fallow rotation where N is applied to the same treatment plots for multiple years. Contact: kevin.larson@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;** Barbarick, K. A.; McDaniel, J.; 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: ken.barbarick@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, N2O and CH4) 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

**Water Quality as Affected by Conservation Tillage and Nutrient Management Under Furrow Irrigation;** Troy Bauder, Erik Wardle, Mazdak Arabi;

**Objectives**:

Evaluate water quality (N, P, and sediment loads) in runoff between conservation systems and utilize results to refine edge of field modeling. Contact: troy.bauder@colostate.edu

**Wetland capacity for nitrate transformation and uptake at the edge of irrigated corn fields:** Erick Carlson; PhD Student Colorado State University

**Publications:**

Sterle, D.\*, G. Litus, F. Stonaker, S. Ela, and J.G. Davis. 2015. The effect of cyanobacteria biofertilizer on Western Colorado organic peach quality and yield characteristics. Proc. of the Western Nutrient Management Conference. March 5-6, 2015; Reno, NV.

Sukor, A.\*, C. Ramsey, and J.G. Davis. 2015. Effects of commercial organic and cyanobacterial fertilizers on instantaneous water use efficiency in drip irrigated organic sweet corn. Proc. of the Western Nutrient Management Conference. March 5-6, 2015; Reno, NV.

Wardle, E. Bauder, T, and C. Pearson. 2015. Guidelines for Using Conservation Tillage Under Furrow Irrigation (Second Edition). Colo. Ag. Expt. Station Bulletin TR15-10.

Wenz, J.\*, H.N. Storteboom, and J.G. Davis. 2015. Effects of enhanced mixing and minimal CO2 supplementation on biomass and nitrogen concentration in a nitrogen-fixing Anabaena sp. cyanobacteria biofertilizer production culture. Proc. of the Western Nutrient Management Conference. March 5-6, 2015; Reno, NV.

Wickham, A.\*, and J.G. Davis. 2015. Effect of liquid organic fertilizers and seaweed extract on Daucus carota var. sativus growth characteristics. Proc. of the Western Nutrient Management Conference. March 5-6, 2015; Reno, NV.

**2015-16 Report to WERA-103**

**University of Hawaii**

Soil Science Update at the University of Hawaii

**Retirements**

Dr. M. Habte, Soil Microbiologist, retired October, 2015.

Dr. M. Gallo will step down as Dean of CTAHR in July 2016 after 4 years of service.

**New Hires**

Department of Tropical Plant and Soil Sciences

Dr. Nhu Nguyen was hired in the position of Assistant Research in Environmental Soil Microbiology and will join the department in August 2016

Dr. Noa Lincoln joined the department in August 2015 as Assistant Researcher in Indigenous Cropping Systems.

Dr. Orville Baldos was hired in August 2015 as Assistant Extension Specialist in Fruits and Nuts

Dr. Michael Muszynnski was hired as Assistant Professor on Plant Growth and Development in May 2015.

Dr. Alyssa Cho, Assistant Researcher Sustainable Farming systems, was hired in June 2015.

Dr. Michael Kantar, Assistant Researcher Vegetable Crops, was hired in January 2016

Department of Natural Resources and Environmental Management

Dr. Rebecca Ryals. Assistant Professor in Agricultural Ecosystem Ecology, was hired in June 2015.

Extension Agents

Frederick Reppun, Junior Agent, Food Safety and Food Security, Honolulu County

Joshua Silva, Junior Agent, Master Gardener Program and Sustainable Agriculture, Kauai County

Marisol Quintilla-Tormel, Junior Agent, Sustainable Agriculture, Hawaii County

Dr. Cynthia Nazario-Leary, Assistant Extension Agent, Master gardener Program, Maui County

**Research Update**

Cover Cropping – Dr. K H. Wang, Assistant Researcher in the Department of Plant and Environmental Protection Sciences, received an NRCS (CIG) grant to develop a N calculator and study cover crop effects on soil health..

Biochar –Drs Deenik and Crow continue to study biochar effects on greenhouse gas emissions, nutrient cycling, microbial community structure, and effectiveness to alleviate Mn toxicity through field, greenhouse and laboratory studies.

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 has been produce.

Integrated livestock/Cropping Systems for the Remote Pacific Islands – Dr. Deenik, G. Fukumoto (CES Kona) and local community groups continue to expand the use of dry litter piggery technology in Pohnpei. Efforts to map the agroforest on Pohnpei. Agroforest yield data has been collected, and analysis is underway to compare household agroforest productivity and household dietary choices..

**Publications**

Journal publications

Butnan, S., J.L. Deenik, Banyon, T., M.J. Antal, Jr, and P. Vityakon. 2016.Biochar properties influencing greenhouse gas emissions in tropical soils differing in texture and mineralogy. Journal of Environmental Quality. Accepted.

Crow, S.E, M. Reeves, O.S. Schubert, and C.A. Sierra. 2015. Optimization of method to quantify soil organic matter dynamics and carbon sequestration potential in volcanic ash soils. Biogeochemistry 123(1):27-47

Deenik, J. L. and M.J. Cooney. 2016. The potential benefits and limitations of corn cob and sewage sludge biochars in an infertile Oxisol. Sustainability 8(2):131-149.

Hinds, J., K.H. Wang, and C.R.R. Hooks. 2016. Growth and yield of zucchini squash (Cucurbita pepo L.) as influenced by a sunn hemp living mulch. Biological Agriculture and Horticulture32(1):21-33.

Meki, M.N, J.R. Kinry, A.H. Youkhana, S.E. Crow, R.M. Ogoshi, M.H. Nakahata, R. Tirado-Corbala, R.G. Anderson, J. Osorio, and J. Jeong. 2015. Two-Year Growth Cycle Sugarcane Crop Parameter Attributes and Their Application in Modeling. Agronoly Journal 107(4):1310-1320.

Paudel, B., C. Chan, J. Halbrendt, S.E. Crow, T.J.K. Radovich, and G. Norton. 2016. Bioeconomic optimization of conservation agriculture production systems (CAPS) for smallholder tribal farmers in the hill region of Nepal. Journal of Soil and Water Conservation 71(2):103-117.

Wells, J.M., S.E. Crow, R. Ogoshi, B. Turano, and A. Hashimoto. 2015. Optimizing feedstock selection for biofuel production in Hawaii: CuO oxidative lignin products in C-4 grasses. Biomass and Bioenergy 83:511-515.

Theses

*P.hD*

Falinsky, K. Predicting Sediment Export into Tropical Environments to Support Ridge to Reef Management. November 2015.

**2015 Report to WERA-103**

**Montana State University**

**Personnel changes**

**Dr. Roger Nkoa Ondoua, Assistant Professor/Nutrient Management,** was hired to replace Olga Walsh at Western Triangle Ag Research Center in Conrad.

**Dr. Pat Carr, Associate Professor/Cropping Systems,** was hired to replace Dr. Chen at the Central Ag Research Center in Moccasin.

**Dr. Chengci Chen, Professor/Cropping Systems,** is the new superintendent at the Eastern Ag Research Center in Sidney, and will also work on soil fertility issues and pulse production.

**Dr. Kefyalew Desta, Assistant Professor/Cropping Systems,** retired from the Northern Ag Research Center in Havre. Screening has started for his replacement.

**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. Three alternative management practices (slow release N, peas instead of fallow, and split application) have been tested in duplicate on three fields in the basin over a two year period, with fallow replacement showing the most promise to reduce leaching and increase revenue.

Cropping Systems – **Ds. Perry Miller and Clain Jones** continue to investigate the effect of previous crop (legumes, brassicas, small grains) and crop rotation on N requirements and availability. They are assessing effect of cropping system on nutrient availability by planting a single crop at two N rates across their 14 year old Crop Diversification Rotation Study, now three years after that study was completed. Previous N rate affected winter wheat grain protein 2 years after study completion.

Cover crop cocktails – **Dr. Miller, Dr. Jones, and Dr. Zabinski** are evaluating 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. **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. Engel** is evaluating N placement and source on winter wheat.

Nitrogen immobilization – **Dr. Engel** found that N in ammonia based fertilizers is immobilized significantly more than in nitrate based fertilizers, leading to significantly different N recoveries in grain.

Long term effects of cropping system and N rate on SOC and SON – **Drs. Engel and Miller** found that ten years of recropping resulted in significantly more SOC than in crop fallow systems and there was a very strong relationship between biomass returned (shoot, root, and rhizodeposition) and SOC. Higher N rate also built SOC more than lower N rate.

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 are to: 1) determine alfalfa crop response in yield and quality to different boron application rates, and 2) identify optimum timing of boron applications. After analyzing year 1 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 will be added, looking to evaluate the impact of water availability on boron uptake in alfalfa.

Variety specific-response to N x water levels. **Drs. Torrion and Stougaard** found that in Northwestern MT, there is a wide variability of varietal response to N x water associations. In particular, spring wheat variety Volt showed to be 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. Similar study will be conducted in 2016 by **Drs. Torrion, Stougaard, and Talbert** to characterize the change of plant N economy in Egan – a newly commercialized high grain protein content with high protein gene *Gpc-B1* of Montana State University. This study will conducted in 2 parts. First will be in both irrigated and dryland on 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.

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.

**Publications**

**Journal publications**

Engel, R., Gravens, E., Towey, B. D. 2015. Degradation of the urease inhibitor NBPT as affected by soil pH. Soil Sci. Soc. Am. J *79:*1674-1683.

Long, D., Whitmus, J., Engel, R., Brester, G. 2015. Net returns from terrain-based variable-rate nitrogen management. Agron. J. 107:1055-1067.

Miller, P., A. Bekkerman, C.A. Jones, M.H. Burgess, J.A. Holmes, and R.E. Engel. 2015. Pea in rotation with wheat reduced uncertainty of economic returns in southwest Montana. Agronomy Journal. 107(2): 541-550. doi:10.2134/agronj14.0185. Open Access.

O’Dea, J., C. Jones, C. Zabinski, P.R. Miller, and I. Keren. 2015. Legume and cropping intensity effects on selected soil quality attributes after eight years in a dryland wheat agroecosystem. Nutrient Cycling in Agroecosystems. 95:179-194. doi: 10.1007/s10705-015-9687-4. Open Access.

Romero, C. M., Engel, R., Chen, C., Wallander, R. 2015. Microbial immobilization of nitrogen-15-labeled ammonium and nitrate in an agricultural soil from Central Montana. Soil Sci. Soc. Am. J 79:595-602.

**Extension publications**

Engel, R. and C. Jones. 2015. Ammonia loss from surface-applied urea to cold soils: A second look. Montana Fertilizer eFacts. No. 70. June 2015. MSU Extension. 3 p. <http://landresources.montana.edu/fertilizerfacts>

Ewing, S, W. Sigler, Jones, C., Jackson-Smith. D. 2015. Judith Basin Nitrogen Project Research Update. Newsletter #4: Sources of nitrate in shallow groundwater. July 2015. 2 p. <http://waterquality.montana.edu/judith/images-files/Newsletter4.pdf>

Glunk, E., K. Olson-Rutz, M. King, D. Wichman, C. Jones. 2015. Nitrate Toxicity of Montana Forages. MT200205AG. Revised 3/15 (extensively). 7 p. <http://landresources.montana.edu/soilfertility/documents/PDF/pub/NitrateToxMT200205AG.pdf>

Jones, C., R. Kurnick, P. Miller, K. Olson-Rutz, C. Zabinski. 2015. 2015 Montana Cover Crop Survey Results. 15 p. <http://landresources.montana.edu/soilfertility/documents/PDF/reports/2015CCSurveyReport.pdf>

Jones, C. W. Sigler, Ewing, S., Jackson-Smith. D. 2015. Judith Basin Nitrogen Project Research Update. Newsletter #3: How do alternative management practices affect nitrate leaching and net profit? July 2015. 2 p. <http://waterquality.montana.edu/judith/images-files/Newsletter3.pdf>

Jones, C. and K. Olson-Rutz. 2015. Feeding the Garden Soil. The Soil Scoop. <http://landresources.montana.edu/soilfertility/thesoilscoop.html>. 2 p.

Jones, C. and K. Olson-Rutz. 2015. Forages: N management. The Soil Scoop. <http://landresources.montana.edu/soilfertility/thesoilscoop.html>. 2 p.

Jones, C. and K. Olson-Rutz. 2015. Forages: P, K, S, and micronutrient management in forages. The Soil Scoop. <http://landresources.montana.edu/soilfertility/thesoilscoop.html>. 2 p.

**Proceedings and Abstracts**

Engel, R., Towey, B. , Gravens, E. 2015 Soil pH Affects Degradation of the Urease Inhibitor NBPT. ASA, CSSA & SSSA International Annual Meeting, Minneapolis, MN, November 18, 2015.

Engel, R., Miller, P., McConkey, B. Wallander, R., Feddema, R. 2015. Soil Organic C Changes in Response to 10-Yr of Increasing Cropping System Intensity in Montana. ASA, CSSA & SSSA International Annual Meeting, Minneapolis, MN, November 18, 2015.

Housman, M., S. Tallman, C.A. Jones, P.R. Miller and C. Zabinski. 2015. Cover Crop Diversity to Improve Soil Health in Dryland Wheat Systems of Montana. American Society of Agronomy Annual Meeting Abstracts. Minneapolis, MN. Nov 15 – 18, 2015.

Jones, C., P. Miller, M. Burgess, S. Tallman, M. Housman, J. O’Dea, A. Bekkerman, and C. Zabinski. 2015. Cover cropping in the semi-arid west: effects of termination timing, species, and mixtures on nitrogen uptake, yield, soil quality, and economic return. In Western Nutrient Management Conference Proceedings. 11:39-44. Reno, Nev. Mar. 5-6, 2015.

Jones, C., A. John, S.A. Ewing, W.A. Sigler, D. Jackson-Smith, A. Bekkerman, P.R. Miller. 2015. Fallow replacement in dryland wheat cropping systems to increase economic returns and improve water quality in semi-arid central Montana. American Society of Agronomy Annual Meeting Abstracts. Minneapolis, MN. Nov 15 – 18, 2015.

Jones, C., R. Kurnick, P. Miller, K. Olson-Rutz, C. Zabinski. 2015. Cover Crop Decision Making: Information Sources and Barriers/Incentives for Adoption Based on a Montana Producer Survey. American Society of Agronomy Annual Meeting Abstracts. Minneapolis, MN. Nov 15 – 18, 2015.

Romero, C., Engel, R. , Chen, C., Wallander, R. 2015. Greater Recovery of Fertilizer Nitrate vs. Ammonium Sources in Agricultural Soils of Central Montana. ASA, CSSA and SSSA International Annual Meeting, Minneapolis, MN., November 18, 2015.

Romero, C., Engel, R., Chen, C., Wallander, R., Bode, E., Marlen, M. 2015. Vertical Distribution and Stratification of Organic Carbon Fractions in a Semi-Arid Calcareous Soil. ASA, CSSA & SSSA, Minneapolis, MN. November 16, 2015.

Sigler, W., Ewing, S., Jones, C., Payn, R., Brookshire, E., Gary, W. 2015. Montana AWRA-MWCC Annual Meeting, "Connecting soil water, groundwater and streams to inform nitrogen sources & flux through a dryland agricultural landscape in the Upper Missouri River Watershed," AWRA and MWCC, Missoula, MT. October 9, 2015.

**Report to WERA 103: New Mexico State University**

**Accomplishments for Multi-Sate NIFA Report**

**Personnel – New Hires**

Dr. Rajan Ghimire – Agricultural Science Center at Clovis

Dr. Nicole Pietrasiak – Soil Microbiology

Interviewing for Soil Pedologist (Asst Prof) and Soil or Environmental Science Assoc/Professor

**Grants**

Developing Digital Tools to Improve Soil Sampling and Analysis for Sustainable Agriculture in the Western U.S. Western SARE Competitive Grants. Professional Development Program. WERA103 Participants: Robert Flynn (NM), Jim Walworth (AZ), Joan Davenport (WA), Troy Bauder (CO). Summary: We used time-lapse video, scientific visualizations, demonstrations and animations to illustrate key soil related concepts and the reasons behind recommended soil testing and management practices. These resources can be used at grower and farm adviser workshops or for just-in-time mobile training for Extension/NRCS professionals working with farmers or other professionals.

**Publications – Refereed**

Yao, S., Guldan, S. J., Flynn, R. P., Ochoa, C. (2015). Challenges of Strawberry Production in High-pH Soil at High Elevation in the Southwestern U.S.. *HortScience, 50*(2), 254-258.

**Publications – Extension**

NMSU Circular 676: Interpreting Soil Tests: Unlock the Secrets of Your Soil. By Robert Flynn, <http://aces.nmsu.edu/pubs/_circulars/CR676.pdf>

Idowu, O. J., Flynn, R. P. (2015). Growing Plants in Caliche Soils. *Guide A-151*. NMSU, Cooperative Extension Service. aces.nmsu.edu/pubs/\_a/A151.pdf

Flynn, R. P. (2015). *Test Your Garden Soil*. *Guide A-114: NMSU, Cooperative Extension Service.* [*http://aces.nmsu.edu/pubs/\_a/A114.pdf*](http://aces.nmsu.edu/pubs/_a/A114.pdf)

Flynn, R. P., Idowu, O. J. (2015). Nitrogen Fixation by Legumes. *Guide A-129*. NMSU, Cooperative Extension Service. aces.nmsu.edu/pubs/\_a/A129.pdf

Flynn, R. P. (2015).*: Inoculation of Legumes*. *Guide A-130. NMSU, Cooperative Extension Service. http://aces.nmsu.edu/pubs/\_a/A130.pdf*

**2014 Oregon State University Report to WERA-103**

**(March 2015)**

**Ongoing research, Vegetable and field crops**

Fine-tuning P and K fertilizer rates for snap beans. Heinrich, Peachey. Western OR.

2015: New OSU nutrient management guide for snap beans (2016, in review). 2015 results: Current starter P fertilizer applications to beans supply 2 to 3 times more P than is taken up by a snap bean crop. Farmers are co-applying N and P in starter, basing the fertilizer rate on supplying N at about 30 to 50 lb per acre. Recommendation to growers is to limit P fertilizer application rate to P uptake by beans by applying starter at a lower P rate. Current P rates are the outcome of using materials with a low N:P ratio (e.g. 10-34-0, 16-20-0, 11-52-0).

Increasing liming efficiency on processed vegetable farms. “Ultra-fine” lime efficacy. Heinrich, Peachey. Western OR.

2015: Ultra-fine lime performed similarly to the standard ag lime as determined by several methods (field and laboratory). Small differences observed during first weeks after application (more rapid pH rise with ultrafine lime product). No difference at 6 months after application. Conclusion: in most situations, ultrafine lime application costs 3X that of traditional aglime, so its use is hard to justify.

Enhanced efficiency fertilizer technologies for improved production in sweet corn: 1) ESN and nitrate leaching, and 2) Urease inhibitor (NBPT) and ammonia loss. Heinrich, Peachey, Sullivan. Western OR.

2015: In spite of applying extra "rainfall" (by sprinkler irrigation) during first 6 weeks after seeding, no difference in soil mineral N retention in top 2 feet of soil at 6 weeks after seeding. In spite of ideal conditions for NH3 loss (surface dry urea application on moist soil, daytime temps > 90 oF, windy afternoons, NH3 loss was less than 5% of urea-N applied. We are concluding that N application to Willamette Valley processed vegetable crops is efficient, even without the aid of N fertilizer additives.

Effect of pop-up fertilizers and planting density on early season sweet corn growth and ear yield. Peachey, Heinrich. Western OR.

2015: Yield increases were found with increased plant population. Higher plant populations did not respond to starter fertilizer application. At present soil test values in WV soils (all >50 ppm Bray P1, most > 75 ppm Bray P1), enough P is available to support high plant populations even in May, when soils are cool (around 60 to 65 oF).

Ammonia loss from conventional vs. alternative N fertilizers. Sarah Del Moro thesis (Sullivan).

2015: Sarah DelMoro defended her thesis in spring term 2015. April Leytem served on her graduate committee, and provided invaluable guidance on interpretation of ammonia loss data. One chapter of thesis (effect of urea fertilizer additives and alternative fertilizers) is almost ready for submission to a journal. Thesis is available online at OSU Scholar's Archive. The research on NH3-N loss from minipivots was not included in the thesis. Reason: too much contamination by fugitive NH3-N from adjacent fields.

Potassium chloride vs. potassium sulfate fertilizers for potatoes. Sarah Light thesis (Sullivan).

2015-16: Sarah Light will defend her MS thesis in April. Her thesis includes some interesting data on the effect of K fertilizer timing for potato grown on very sandy soil. Chloride uptake was lower when KCl was applied the fall prior to potato, demonstrating that Cl moved below rooting depth. This trial was done on soil with extractable K of 400+ ppm (above K fertilizer response threshold). Under these conditions (high soil K, considerable Cl in soil without current season K application), differences in midseason petiole NO3-N for potassium chloride or potassium sulfate fertilizers were small (<0.2% NO3-N). Thesis data supports current practice of using KCl on potato at moderate rates, when the K soil test does not indicate K deficiency. For fields with low K soil test (not included in this study) that may require high rates of K fertilizer application (> about 300 lb K2O per acre), applying some of the K as potassium sulfate is recommended.

Nitrogen Fertilizer Rate and Application Timing on Yield, Protein and Fate of N in Soil and Wheat Crop. Tracy Wilson, Marvin Butler, Neil Christensen. Central Oregon Expt Station (Madras). Measurements of agronomic parameters (yield, protein, test weight, N uptake, etc.) in large-scale plots (90 x 300 ft) while the fate of applied N is being measured in micro-plots fertilized with 15N-labeled urea.

2015 was second and final year for this project. Tracy Wilson at Central Oregon Experiment Station is project contact.

Nitrogen fertilizer replacement value of specialty organic fertilizers. Sullivan.

2015: Dry organic fertilizers with total N of 4 to 12% were evaluated by broadcasting on wheat at late tillering growth stage, and determining N fertilizer equivalency with a reflectance meter (Greenseeker) and by grain harvest. Median N equivalency was 50% for most dry organic fertilizers that can be used in conjunction with certified organic production. Nitrogen uptake was reasonably efficient from the dry fertilizers even though they were broadcast at same growth stage used for conventional fertilizer (urea) application. Laboratory incubations confirmed that N release rate is rapid for these high analysis organic fertilizers (most of plant-available N was released at 2 weeks at 72 oF).

**Ongoing research, berry crops**

Drs. Strik and Bryla continue to research blackberry and blueberry nutrient management in both organic and conventional systems. Current projects focus on systems where nutrients are fertigated on raised beds by drip irrigation. Many publications in 2015 (see list). A new project evaluates fertility management of blueberry grown in large pots in a greenhouse in nursery media. Container grown systems for blueberry production have some advantages for high value markets, especially in regions with marginal soil/climate for blueberry production. Many publications are available online via Bryla's webpage (USDA-ARS, Horticultural Crops Research, Corvallis).

 **Publications**

**Research**

Bryla, D.R. and Strik, B.C. 2015. Fertilizer and soil management practices for improving the efficiency of nutrient uptake and use in northern highbush blueberry. HortTechnology 25:464-470.

Dixon, E.K., Strik, B.C., and Bryla, D.R. 2016. Weed management, training, and irrigation practices for organic production of trailing blackberry: II. Soil and plant nutrient concentrations. HortScience 51:36-50.

Dixon, E.K., Strik, B.C., and Bryla, D.R. 2016. Weed management, training, and irrigation practices for organic production of trailing blackberry: III. Accumulation and loss of biomass, carbon, and nutrients. HortScience 51:51-66.

Ehret, D.L., Frey, B., Forge, T., Helmer, T., and Bryla, D.R. 2015. Age-related changes with drip irrigation in highbush blueberry. HortScience 50:486-490.

Fernandez-Salvador, J., Strik, B.C., and Bryla, D.R. 2015. Liquid corn and fish fertilizers are good options for fertigation in blackberry cultivars grown in an organic production system. HortScience 50:225-233.

Fernandez-Salvador, J., Strik, B.C., and Bryla, D.R. 2015. Response of blackberry cultivars to fertilizer source in an organic fresh market production system. HortTechnology 25:277-292.

Strik, B.C. and Bryla, D.R. 2015. Uptake and partitioning of nutrients in blackberry and raspberry and evaluating plant nutrient status for accurate assessment of fertilizer requirements. HortTechnology 25:452-459.

Vargas, O.L. and Bryla, D.R. 2015. Growth and fruit production of highbush blueberry fertilized with ammonium sulfate and urea applied by fertigation or as granular fertilizer. HortScience 50:479-485.

Vargas, O.L., Bryla, D.R., Wieland, J.E., Strik, B.C. and Sun, L. 2015. Fertigation with drip and alternative micro irrigation systems in highbush blueberry: a comparison of point and area supply of water and nitrogen. HortScience 50:897-903.

Yeo, J.R., Weiland, J.E., Sullivan, D.M., and Bryla, D.R. 2016. Susceptibility of highbush blueberry cultivars to phytophthora root rot. HortScience 51:74-78.

**Extension publications**

Downing, T. W. (2015). Calibrating dairy manure nutrient application rates (vol. EM 8768). Corvallis, OR: Oregon State University Extension Service.

Downing, T. W., Valencia, M. (2015). El Cálculo de las Tasas de Aplicación de Estiércoles Nutrientes de Granja Lechera (vol. EM 8768-S). Corvallis, OR: Oregon State University Extension Service.

Hart, John M., Bernadine C. Strik, Carolyn DeMoranville, Joan R. Davenport, and Teryl Roper. 2015. (Revised). Cranberries (South Coastal Oregon). A nutrient management guide for south coastal Oregon EM 8672. OSU Extension Service.

Sullivan, D.M., C.G. Cogger, and A.I. Bary. 2015 (Revised). Fertilizing with biosolids. Pacific Northwest Extension Publication 508. Oregon State University Extension Service, Corvallis, OR.

**Agricultural Experiment Station & Commodity Commission Reports**

Heinrich, A.H. and D.M. Sullivan. Increasing liming efficiency on processed vegetable farms (2015). Report to Oregon Processed Vegetable Commission. <http://horticulture.oregonstate.edu/content/increasing-liming-efficiency-processed-vegetable-farms-2015>

Peachey, E. and D. M. Sullivan. Interseeding of Cover Crops to Improve Cover Crop Establishment and Performance (2015). Report to Oregon Processed Vegetable Commission. <http://horticulture.oregonstate.edu/content/interseeding-cover-crops-improve-cover-crop-establishment-and-performance-2015>

Peachey, E. and D.M. Sullivan. Effect of pop-up fertilizers and planting density on early season sweet corn growth and ear yield (2015). Report to Oregon Processed Vegetable Commission. <http://horticulture.oregonstate.edu/content/effect-pop-fertilizers-and-planting-density-early-season-sweet-corn-growth-and-ear-yield-2015>

Pinto, J.M., C.C. Shock, E.B.G. Feibert, L.D. Saunders, and D. Beck. 2015. Onion response to late-season water stress and high nitrogen under two plant populations. p 60-74 In Shock C.C. (Ed.) Oregon State University Agricultural Experiment Station, Malheur Experiment Station Annual Report 2014, Department of Crop and Soil Science Ext/CrS 152. <http://cropinfo.net/pdf/ar/2014/2014-007-OnionWaterStress.pdf>

Reitz, S.R., C.C. Shock, R.A. Roncarati, E.B.G. Feibert, and H. Kreeft. 2015. Effects of copper sulfate on levels of Escherichia coli in irrigation canal water. p 179-183 In Shock C.C. (Ed.) Oregon State University Agricultural Experiment Station, Malheur Experiment Station Annual Report 2014, Department of Crop and Soil Science Ext/CrS 152. <http://cropinfo.net/pdf/ar/2014/2014-018-CopperSulfateEColi.pdf>

Roseberg, R. J., Silberstein, T. B. (2015). Effects of sodium nitrate on stand and yield of organic spring feed barley in the Klamath Basin (2014). (pp. 5). OSU Klamath Basin Research and Extension Center. <https://scisoc.confex.com/crops/2014am/webprogram/Paper88695.html>

Shock, C.C. 2015. Recognizing and correcting iron deficiency, Sustainable Agriculture Techniques. Oregon State University, Department of Crop and Soil Science Ext/CrS 153 4p. <http://www.cropinfo.net/pdf/extension/ExtCrs153-IronDefficiency.pdf>

Shock, C.C., J.M. Pinto, E.B.G. Feibert, and L.D. Saunders. 2015. Onion response to phosphorus application strategies and in-season nutrient supplementation, 2014. p 42-59 In Shock C.C. (Ed.) Oregon State University Agricultural Experiment Station, Malheur Experiment Station Annual Report 2014, Department of Crop and Soil Science Ext/CrS 152. <http://cropinfo.net/pdf/ar/2014/2014-006-OnionFertigation.pdf>

Sullivan, D.M., A. Heinrich and E. Peachey. Enhanced efficiency fertilizer technologies for improved production in sweet corn (2015). Report to Oregon Processed Vegetable Commission. <http://horticulture.oregonstate.edu/content/enhanced-efficiency-fertilizer-technologies-improved-production-sweet-corn-2015>

**Proceedings/Webinars/Abstracts/Other publications**

Anderson, N., Chastain, T., Garbacik, C. (2015). Enhancing Nitrogen Efficiency and Seed Yield in Perennial Ryegrass Crops with Urease Inhibitors. Minneapolis, MN: 2015 International Annual Meeting Abstracts. ASA, CSSA, SSSA. <https://scisoc.confex.com/scisoc/2015am/webprogram/Paper93436.html>

Shock, B.M. E. Hammond, G. Faw, K. Diebel, and C.C. Shock. 2015. Surface Irrigation Degradation of Water Quality in Streams. Annual Meeting of the American Society of Horticultural Science, Sheraton Hotel, New Orleans, LA. August 5. <https://ashs.confex.com/ashs/2015/webprogramarchives/Paper21603.html>

Shock, C.C., M.P. Shock, B.M. Shock, J. Feraz, J. Ramos, and H.M. Saito. 2015. Long-term Revegetation Success on Acid Infertile Subsoils in the Amazon. Annual Meeting of the American Society of Horticultural Science, Sheraton Hotel, New Orleans, LA. August 4. <https://ashs.confex.com/ashs/2015/webprogram/Paper21221.html>

Strik, B. C. (2015). Weed control and fertility in organic blueberry production systems (pp. 6-9). Manchester, NH: New England Vegetable and Fruit Conference. <http://www.newenglandvfc.org/2015_conference/1_3_Strik.pdf>

Strik, B. C., Bryla, D. (2015). Nutrient management of blueberry – Assessing plant nutrient needs and designing good fertilizer programs (pp. 79-94). Corvallis, OR: Proc. OSU Blueberry School. <http://oregonstate.edu/dept/NWREC/sites/default/files/pg_programs/berry/documents/079-093-nutrient_management.pdf>

Sullivan, D.M., B.C. Strik, and Bryla, D.R. 2015. Evaluation of alternative mulches for blueberry over five production seasons. Acta Hort. 1076:171-178. <https://www.researchgate.net/publication/282265205_Evaluation_of_alternative_mulches_for_blueberry_over_five_production_seasons>

**Thesis/Dissertation**

Del Moro, Sarah K. 2015. Ammonia Volatilization from Nitrogen Fertilizers and Wastewater Reuse in the Columbia Basin. Scholars Archive. Oregon State University.  <http://hdl.handle.net/1957/56356>

**WERA-103 State Report – Utah 2015**

**Utah State University and Brigham Young University**

**Participating investigators**: 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. Following 10 site years over three growing seasons and in six different counties across Utah, that it is possible to reduce the N requirement for first year corn after alfalfa as much as 200 units of N per acre (based on typical grower practice and USU recommendation levels) without yield reduction. This is projected to potentially save Utah corn growers up to $6 million annually.

Tissue Nutrient Sufficiency Levels in Tree Fruit (Grant Cardon and Brent Black)

The second project was the designed to validate the long time adopted tissue nutrient sufficiency limits used to guide fertility management decisions in Utah tree fruit orchards (primarily tart cherry and peach). Utah ranks among the top three states in tart cherry production nationwide, and much interest has been given over the last 10 years to tailoring nutrient recommendations to Utah-specific growing conditions. The tissue nutrient sufficiency levels used by USU to interpret tissue nutrient test levels were originally adopted from other major fruit growing regions of the US, but without significant local field evaluation. The work included in an MS thesis completed and successfully defended under this project in 2015 indicates that the long time adopted tissue nutrient sufficiency levels appear to function well in Utah orchards, but that there is much room for improvement in increasing nutrient levels in Utah fruit trees primarily for potassium, phosphorus and iron.

**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

**Literature**

Creech, E., G. E. Cardon, J. Barnhill, J. Gale, C. Israelsen, B. Kitchen, M. Nelson, and M. Pace. 2015. The Potential for Reducing N Fertilizer Inputs for Corn Production in the First Year Following Alfalfa. Utah State University Extension Fact Sheet, AG/Crops/2015-01pr.

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

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**Washington State University**

**April 2016**

**Report to WERA-103**

Accomplishments for multi-state CSREES report:

**Ongoing Research:**

* **(Davenport) Developing Management Strategies for limited and impaired water sources for grape.** This SCRI funded project is being conducted collaboratively with Drs. Jim Ayars and Andrew McElrone of the USDA/ARS. We are evaluating water management as well as plant response to salinity on table, juice, raisin and wine grape. The project was completed in 2015.
* **(Davenport) Phosphorus nutrient management and comparative studies between P defcient and grapevine leafroll.** Funded by the Washington State Grape and Wine Funds, this 2 year field trial compared foliar and liquid soil application of P to P deficient as well as virus affected red wine grapes (Merlot and Cabernet Sauvignon.
* **(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.
* **(Huggins, Sherratt, Kennedy) Mitigating Agricultural Sources of Particulate Matter and Greenhouse Gas Emissions in the Pacific Northwest.** USDA/ARS Appropriated Funds. Characterize key environmental and management drivers of agricultural wind-blown dust and PM10/PM2.5 emissions that will improve process-oriented models and decision aids. Develop techniques for identifying sources of PM10/PM2.5 to better associate management practices with PM10/PM2.5 emissions and to corroborate models. Characterize roles of environmental and management drivers on soil C and N cycling as factors regulating GHG (N2O, CO2) emissions from agricultural soils. Develop agricultural PM10/PM2.5 and GHG mitigation strategies and managment decision aids for Pacific Northwest cropping systems.
* **(Huggins) Long-Term Agroecosystem Research (Ltar) for Dryland Cropping Systems of the Northwest.**  USDA/ARS Appropriated Funds. Objective: To strengthen and enhance ongoing research for the Cook Agronomy Farm LTAR with emphasis on long-term assessment of soil health, nutrient cycling, crop performance, water quality and greenhouse gas emissions. Approach: Field and laboratory based research on climate change and management impacts on soil health issues including on C, N, P cycling and flows, soil acidification, greenhouse gas fluxes, crop performance including nutrient use efficiency metrics and soil chemical balances associated with inputs and losses via crop, water and air.

**Publications:**

**Research**

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**Extension**

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**Theses**

#### Stout, J. E. Developing sustainable irrigation practices in Cabernet Sauvignon and Concord vineyards in Central Washington. Ph.D., Soil Science, Washington State Univeristy, May 2015.

**Personnel:**

New hire: Dr. Haiying Tao, WSU main campus, dryland cropping systems soil management, Extension/Research (August 2015)

Retirement: Dr. Craig Cogger, WSU Puyallup, June 2015.