

## **WERA-103: Nutrient Management and Water Quality**

### **Statement of Issues and Justification**

Nutrient management in the Western Region is becoming increasingly important because of the need to increase productivity while mitigating environmental impacts without conversion of additional non-agricultural lands. Proper nutrient management contributes to healthy soils and optimal crop production to create climate-resilient farms and ranches that will meet expanding needs for food, fiber, and bioenergy. Improper use of nutrients can lead to soil degradation, air and water pollution, and reduced profitability, productivity, and water use efficiency. Agriculture produces as much as one-third of global greenhouse-gas (GHG) emissions, a large proportion of which is from production and use of nitrogen fertilizers (Gilbert, 2012). Maximizing crop-nutrient use efficiency with proper nutrient management that includes integration of a wide range of new tools and emerging technologies is needed to reduce agricultural GHG emissions while increasing GHG sequestration and enhancing soil health and productivity. The semi-arid climate in much of the western region creates unique challenges for continued sustainable production in the changing and more unpredictable climate. The regional multi-institutional forum provided by WERA-103 will become increasingly important for development of research and education programs to meet those challenges.

Best Management Practices (BMPs) for crops and cropping systems must evolve with emerging technologies to maximize nutrient use efficiency and reduce or mitigate adverse environmental impacts. WERA-103 provides a collaborative forum that has proven to be effective for federal agencies, universities, private industry, and non-profit organizations in the western region to identify and reduce negative economic and environmental impacts of poor nutrient management. This type of regional cooperation is needed more than ever to develop reliable, consistent, science-based recommendations. Information sharing on a region-wide basis improves accuracy and efficiency, reduces duplication of effort, and leads to effective multi-state problem-solving research, extension, and education. This project has provided and continues to provide a unique and powerful educational and outreach forum for scientists, industry representatives, governmental agencies, and consultants to engage in dialogue concerning nutrient management issues.

BMPs are being developed by scientists for implementation across public and private sectors. Re-evaluation of current nutrient management practices and development of improved techniques to determine specific crop nutrient requirements provides the foundation for increasing efficiency and profitability of nutrient use, while improving soil, water, and air quality. Additionally, quantifying nutrient cycling in extensively managed ecosystems supports improved forest and rangeland management practices and provides important insight to processes occurring in more intensively managed agricultural soils. The use of organic nutrient sources, such as manure and compost, also pose challenges to efficient utilization and environment protection. Accurate soil, water, and plant analytical information is essential for making wise nutrient management decisions. The cooperation and continuing education of analytical labs and agricultural consultants is important for providing accurate information to local decision makers. Outputs from this project provide a sound footing for decisions by industry, government, producers, and scientists.

## Objectives

The overarching goal of this project is to bring together experts on soil fertility and nutrient management from industry, academia, government agencies, and non-profit organizations in the Western Region to deliberate on the challenges in sustainable crop production in this region and to foster regionally collaborative research, extension, and educational efforts to achieve the following objectives:

1. ***Improve crop nutrient recommendations*** based on evolving knowledge, technology, and societal priorities;
2. ***Develop strategies for sustainable agricultural production*** that support increased yields without adverse environmental impacts or conversion of additional non-agricultural lands;
3. ***Create educational programs and outreach materials*** on the principles of soil-plant-animal-water systems, soil properties that affect nutrient management, best soil/amendment testing and nutrient recommendation practices, and new research-based management strategies.

## Procedures and Activities

### Procedures for Objective 1, Improve Nutrient Recommendations:

1. Facilitate regional research-extension-education collaborative projects to improve crop nutrient recommendations;
2. Develop/refine regional nutrient use standards for western crop and forage production systems;
3. Integrate emerging soil-health assessment techniques into improved crop nutrient recommendations;
4. Evaluate and support adoption of new nutrient analytical techniques and interpretive methodologies.

### Procedures for Objective 2, Develop strategies for sustainable intensification:

1. Facilitate regional research-extension-education collaborative projects to develop and/or evaluate productivity, nutrient/water-use efficiency, sustainability, and economic feasibility of conservation management systems such as, but not limited to, perennial rotation phases, cover crops, organic amendments, and livestock integration;
2. Evaluate and/or develop standards for use of amendments, biostimulants, nutrient delivery systems, enhanced efficiency fertilizers, and other novel products/approaches for improving nutrient use efficiency;
3. Evaluate and revise soil/plant/water/amendment analysis guidelines to reflect changing management practices;

4. Develop and/or participate in efforts to develop and refine standardized soil health assessment methods, particularly for arid and semiarid regions.

#### Procedures for Objective 3, Create educational programs and outreach materials:

1. Organize and expand the biennial Western Nutrient Management Conference to provide science-based information to consultants, educators, industry representatives, students, and researchers;
2. Contribute to national and regional technical publications as individuals representing the WERA-103 group to provide information primarily to agricultural consultants and educators (i.e., American Society of Agronomy Crops & Soils Magazine). At least one additional periodical outlet will be targeted during this project period;
3. Produce additional video presentations on soil fertility and nutrient management for use in CCA training, extension programming, K-12, and college courses;
4. Develop collaborative efforts to write/revise/publish regionally relevant extension bulletins that extend the latest science-based practices for nutrient management in western crop and forage production systems, targeting producers, consultants, and extension educators.

### **Related, Current, and Previous Work**

Research relating to nutrient use efficiency is conducted throughout the region. Through this regional group, current information is relayed to diverse users including crop consultants, government regulators and agencies, industry, and university researchers. Biennial Western Nutrient Management conferences held in Reno, Nevada during the current project period (2015, 2017, and 2019) extended information on topics that included 1) nitrogen cycling and management; 2) evaluating and managing salt-affected soils; 3) water, soil, manure, and plant testing; 4) data analysis techniques for field studies; 5) nutrient management planning for specific crops and cropping systems; 6) sustainable agricultural systems; and 7) novel organic amendments and biostimulants. This is a major conduit for bringing current research and policy information to user groups. Involvement by graduate and undergraduate students is an important component of the conference and is promoted via presentation competitions and awards.

Recent examples of collaborative products and activities fostered by the WERA-103 committee during the current project period includes:

#### Education programs and activities

- WERA-103 Western U.S. Soil Fertility video series. Ten videos produced by WERA-103 members. Available at <https://www.youtube.com/channel/UCq8g9TDqZwe23oymFlqi2Bw>;
- Understanding Western Soils. 15 short videos for training and classroom use produced by WERA-103 members. Funded by Western SARE. Available at: <https://westernsoils.nmsu.edu/>;

- Six articles published in Crops & Soils Magazine with circulation of ~14,500;

#### Multi-state extension publications

- Moore, A. D., Pirelli, G. J., Filley, S. J., Fransen, S., Sullivan, D. M., Fery, M. A., & Thompson, T. M. (2019). Nutrient Management for Pastures: Western Oregon and Western Washington (EM 9224, p. 16). Corvallis, OR, Benton: OSU Extension and Experiment Station Communications <https://catalog.extension.oregonstate.edu/em9224>
- Moore, A. D., Wysocki, D. J., Chastain, T. G., Wilson, T., Duval, A. S. (2019). Nutrient management guide: Camelina (PNW 718, pp. 5). Oregon State University Extension and Experiment Station Communications. <https://catalog.extension.oregonstate.edu/pnw718>
- Sullivan, D. M., Bary, A. I., & Cogger, C. G. (2018). Worksheet for Calculating Biosolids Application Rates in Agriculture (PNW 511, p. 12). Oregon State University Extension Service. <https://catalog.extension.oregonstate.edu/pnw511>
- Sullivan, D. M., Bary, A. I., Miller, R. O., & Brewer, L. J. (2018). Interpreting Compost Analyses (EM 9217, p. 10). Corvallis, OR: Oregon State University Extension Service. <https://catalog.extension.oregonstate.edu/em9217>
- Sullivan, D. M., Cogger, C., Bary, A. I., & Brewer, L. J. (2018). Biosolids in Dryland Cropping Systems PNW 716, p. 11). Corvallis OR: Oregon State University Extension Service. <https://catalog.extension.oregonstate.edu/pnw716>
- Walsh O.S., D. Tarkalson, A. Moore, G. Dean, D. Elison, J. Stark, O. Neher, and B. Brown. 2019. Southern Idaho Fertilizer Guide: Sugar Beets. CIS 1174. University of Idaho. 15 pp.

#### Multi-state grant-funded research-extension-education projects (funded and proposed)

- Compost and cover crop options in dryland grain systems. Funded by USDA Organic Research & Extension Initiative. Utah State University, University of Wyoming, Montana State University, Washington State University;
- Integrating cover crops and livestock in irrigated cropping systems. Funded by Western SARE and the Northern Plains Climate Hub. University of Wyoming and Montana State University;
- Farmer-driven diversified winter-wheat rotations for improved soil health. Proposal submitted to Western SARE. University of Wyoming and Colorado State University;
- Foundational Knowledge of Soil Health and Organic Matter Processes in High Elevation Irrigated Hay and Pasture Meadows. Proposal submitted to USDA-NIFA-AFRI Foundational and Applied Science Soil Health Program. University of Wyoming and Colorado State University.

#### Laboratory proficiency testing programs

- Expansion of the multi-state Agricultural Laboratory Proficiency Program and the growing Manure and Compost Analysis Proficiency programs (Robert Miller, CSU);

- North American Proficiency Testing (NAPT) Program (with the Soil Science Society of America) continues to be coordinated, supported, and utilized by members of WERA-103;

## **Expected Outcomes and Impacts**

- Improved nutrient management recommendations and nutrient management guides for traditional and alternative crops in the region;
- Improved nutrient management practices by agricultural professionals and industry members through knowledge gained at the biennial Western Nutrient Management Conference;
- Publications (Crops & Soils, online) that highlight current nutrient management issues and research;
- Improved confidence of growers and crop consultants in soil testing services and nutrient recommendations;
- Enhanced understanding of soil ecosystem services, soil fertility and nutrient management by CCA's, extension clientele, K-12, and undergraduate students;
- Improved understanding and confidence in standards for use of amendments, biostimulants, nutrient delivery systems, enhanced efficiency fertilizers, and other novel products/approaches for improving nutrient use efficiency;
- Enhanced knowledge of scientific and technical resources for training, conferences, and grower meetings through educational opportunities in multiple venues throughout the Western region, with invited presentations by committee members;
- Grant-funded collaborative research-extension-education projects among WERA-103 members to address regional nutrient management and sustainable agriculture issues.

## **Educational Plan**

The educational component of WERA-103 will focus on delivery of the latest nutrient management findings and other technology to educators, industry agronomists, government agencies, and other interested parties. This will be done through regional publications, regional conferences, web-based bulletins, and other web-based outlets such as educational videos, short courses and podcasts.

The past efforts by this group include holding the biennial Western Nutrient Management Conference (WNMC), which involves university, government and industry personnel and students sharing their findings, addressing and responding to emerging issues and interacting with a large group to expand the bidirectional understanding of regional needs. The WNMC also fosters additional cooperative research and extension efforts.

Coordination with laboratory proficiency testing programs, including the North American Proficiency Testing Program and Agricultural Laboratory Proficiency Program, and generating associated publications will educate the agricultural industry about continued advances in soil and plant analysis that are calibrated and scientifically rigorous, to support soil and plant analysis programs across the region.

Publications developed by WERA-103 members support university and industry agronomists and educators in ongoing educational efforts in nutrient management and sustainable agriculture. Coordinated efforts of WERA-103 members producing these publications helps to focus research efforts where additional data are needed. The working-group forum facilitated by the WERA-103 project ensures the regional nature, scientific rigor, and combined industry and extension promotion of sound, science-based practices throughout the region.

## **Organization/Governance**

The Committee Chair provides leadership for the committee and is responsible for coordination with the Western Directors, and for planning the annual meeting. The Committee Chair Elect provides support to the Chair and becomes the Chair the following year. The Secretary is responsible for submitting minutes and state reports from the annual meeting and becomes Chair Elect. Officers serve for one year.

An individual is selected from the committee to be the Coordinator of the Western Nutrient Management Conference. This person works closely with the Committee leadership in program planning. Other subcommittees are established as needed to meet the planned programming of WERA-103.

Committee membership is open to qualified nutrient management professionals from a broad range of entities. The committee is currently comprised of representatives of Western region land-grant and other universities, the USDA Agricultural Research Service, fertilizer producers, agricultural testing companies, and The Fertilizer Institute. The interdisciplinary nature of the committee is unique and vital to the group's function.

## **Literature Cited**

Gilbert, N. 2012. One-third of our greenhouse gas emissions come from agriculture. Nature doi:10.1038/nature.2012.11708

## **Land Grant Participating States/Institutions**

AZ, CA, CO, ID, IL, MN, MT, NM, OR, TN, UT, WA, WY

## **Non Land Grant Participating States/Institutions**

Brigham Young University, Dellavalle Laboratory Inc., IDA Consulting Services Inc. , J.R. Simplot CO, Manure, Compost and USGAPT Proficiency Programs, Nutrien, Soiltest Farm Consultants Inc., University of Idaho, USDA-ARS/Arizona, USDA-ARS/Idaho, Western Ag Innovations Inc.

# Participation

Participant Name	Station Name	Objective No.	Research							Extension Program/KA
			KA	SOI	FOS	SY	PY	TY	FTE	
Hopkins, Bryan hopkins@byu.edu	Brigham Young University	1,2,3	102	110	1070	0.10	0.00	0.00	0	
Jones, Clain clainj@montana.edu	Montana - Montana State University	1,2,3				0.00	0.00	0.00	0.9	102
Mooso, Galen galen.mooso@simplot.com	J.R. Simplot CO	1,2,3				0.10	0.00	0.00	0	
Nelson, Dan dan@soiltestlab.com	Soiltest Farm Consultants, Inc	1,2,3	111	210	1020	0.00	0.00	0.00	0.2	102
Bremer, Eric ericbremer@westernag.ca	Western Ag Innovations Inc.	1,2,3	102	110	1070	0.10	0.00	0.00	0	
Greer, Ken kengreer@westernag.ca	Western Ag Innovations Inc.	1,2,3	102	110	1010	0.10	0.00	0.00	0	
Deenik, Jonathan jdeenik@hawaii.edu	Hawaii - University of Hawaii	1,2,3	103	110	1010	0.10	0.00	0.00	0	
Davenport, Joan R. jdavenp@wsu.edu	Washington - Washington State University	1,2,3	102	110	2000	0.25	0.25	0.20	0	
Rogers, Christopher W cwrogers@uidaho.edu	Idaho - University of Idaho	1,2,3	205	1550	1070	0.10	0.00	0.00	0	
Walworth, Jim walworth@ag.arizona.edu	Arizona - University of Arizona	1,2,3	102	110	2000	0.10	0.00	0.00	0.1	102
Walsh, Olga owalsh@uidaho.edu	Idaho - University of Idaho	1,2,3	103	110	2000					103
Wright, Glenn C gwright@ag.arizona.edu	Arizona - University of Arizona	1,2,3	102	1211	2000	0.10	0.00	0.00	0.1	102
Bauder, Troy A troy.bauder@colostate.edu	Colorado - Colorado State University	1,2,3	102	110	2000	0.10	0.00	0.00	0	
Dellavalle, Nat B. n.dellavalle@dellavallelab.com	Dellavalle Laboratory, Inc	1,2,3	102	930	1010	0.10	0.00	0.00	0.1	102
Sullivan, Dan dan.sullivan@oregonstate.edu	Oregon - Oregon State University	1,2,3	204	1050	1010	0.10	0.00	0.00	0.1	204
Hartz, Timothy K tkhartz@ucdavis.edu	California -Davis : University of California, Davis	1,2,3	205	1199	1010	0.10	0.00	0.00	0.1	205
Tyner, John S jtyner@utk.edu	Tennessee - University of Tennessee	1,2,3	102	210	2061	0.10	0.00	0.00	0.25	102
LIANG, XI xliang@uidaho.edu	University of Idaho	1,2,3	102	110	2061	0.10	0.00	0.00	0.25	102
Miller, Robert O miller@lamar.colostate.edu	Manure, Compost and USGAPT Proficiency Programs	1,2,3	102	110	2061	0.10	0.20	0.20	0.2	
Zhang, Yuanhui yzhang1@illinois.edu	Illinois - University of Illinois	1,2,3	103	5210	2000	0.10	0.00	0.00	0	
Fernandez, Fabian G fabiangf@umn.edu	Minnesota - University of Minnesota	1,2,3	102	1499	1060	0.00	0.00	0.00	1	102
Tindall, Terry A terry.tindall@simplot.com	J.R. Simplot CO	1,2,3	111	210	2030	0.10	0.10	0.10	0	
Bronson, Kevin Kevin.Bronson@ARS.USDA.GOV	USDA-ARS/Arizona	1,2,3	112	320	2050	0.20	0.00	0.00	0.3	102

Norton, Jay B. jnorton4@uwyo.edu	Wyoming - University of Wyoming	1,2,3	102	2410	1070	0.05	0.00	0.00	0.05	102
Norton, Urszula unorton@uwyo.edu	Wyoming - University of Wyoming	1,2,3	102	2410	1070	0.05	0.00	0.00	0.05	
Cardon, Grant E grant.cardon@usu.edu	Utah - Utah State University	1,2,3				0.00	0.00	0.00	0.25	101 103
Tarkalson, David david.tarkalson@ars.usda.gov	USDA-ARS/Idaho	1,2,3	102	110	2020	0.10	0.00	0.00	0	
Flynn, Robert P rflynn@nmsu.edu	New Mexico - New Mexico State University	1,2,3	102	110	2061	0.10	0.00	0.00	0	
Ippolito, James Jim.Ippolito@ColoState.EDU	Colorado - Colorado State University	1,2,3	102	110	2000	0.10	0.00	0.00	0.1	102
Kulesza, Stephanie steph@idahodairymens.org	IDA Consulting Services, Inc.	1,2,3	0	0	0	0.00	0.00	0.00	0.2	102
Brooks, Erin ebrooks@uidaho.edu	Idaho - University of Idaho	1,2,3	102	110	2020	0.40	1.00	1.00	0	0
Tao, Haiying haiying.tao@wsu.edu	Washington - Washington State University	1,2,3	102 102	110 110	2000 2090	0.10	0.00	0.00	0	0
Moore, Amber D amber.moore@oregonstate.edu	Oregon - Oregon State University	1,2,3	102	110	1060	0.10	0.00	0.00	0	0
Geisseler, Daniel djgeisseler@ucdavis.edu	California -Davis : University of California, Davis	1,2,3	102	110	1060	0.00	0.00	0.00	0.05	102
McGee, Eric ericm@qualitechco.com	Qualitech	1,2,3	102 102	110 1212	2000 2000	0.10	0.00	0.00	0	0
Ellsworth, Jason W jellsworth@wilburellis.com	Wilbur-Ellis Company	1,2,3	0	0	0	0.00	0.00	0.00	0	0
Walia, Maninder waliam@unce.unr.edu	Nevada Cooperative Extension	1,2,3	102 204 0 0 0	1599 1410 1899 2499 1699	0 0 0 0 0	0.05	0.00	0.00	0	0

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
<b>Grand Total:</b>	<b>6.00</b>	<b>2.65</b>	<b>2.60</b>
0 - 0 - 0	0.00	0.00	0.00
0 - 1899 - 0	0.05	0.00	0.00
0 - 1899 - 0	0.05	0.00	0.00
0 - 2499 - 0	0.05	0.00	0.00
102 - 110 - 1010	1.10	1.00	1.00
102 - 110 - 1060	0.10	0.00	0.00
102 - 110 - 1070	0.30	0.00	0.00
102 - 110 - 2000	0.65	0.25	0.20
102 - 110 - 2020	0.50	1.00	1.00
102 - 110 - 2061	0.40	0.20	0.20
102 - 110 - 2090	0.10	0.00	0.00
102 - 199 - 1060	0.10	0.00	0.00
102 - 210 - 2061	0.10	0.00	0.00
102 - 930 - 1010	0.10	0.00	0.00
102 - 1211 - 2000	0.10	0.00	0.00
102 - 1499 - 1060	0.00	0.00	0.00
102 - 1549 - 1020	0.20	0.00	0.00
102 - 1599 - 0	0.05	0.00	0.00
102 - 2410 - 1070	0.10	0.00	0.00
103 - 110 - 1010	0.10	0.00	0.00
103 - 110 - 2000	0.10	0.00	0.00
103 - 1211 - 2000	0.10	0.00	0.00
103 - 5210 - 2000	0.10	0.00	0.00
111 - 210 - 1020	0.00	0.00	0.00
111 - 210 - 2030	0.10	0.10	0.10
111 - 210 - 2061	0.10	0.00	0.00
112 - 320 - 2050	0.10	0.10	0.10
133 - 399 - 2020	0.10	0.00	0.00
133 - 410 - 2020	0.10	0.00	0.00
203 - 110 - 1070	0.10	0.00	0.00
204 - 1050 - 1010	0.10	0.00	0.00
204 - 1410 - 0	0.05	0.00	0.00
205 - 110 - 1010	0.10	0.00	0.00
205 - 110 - 1070	0.10	0.00	0.00
205 - 1199 - 1010	0.10	0.00	0.00
205 - 1550 - 1020	0.20	0.00	0.00
205 - 1550 - 1070	0.10	0.00	0.00

Program/KA	Total FTE
*	0.35
0	0
101	0.25
102	4.65
103	0.95
111	0.2
204	0.1
205	0.4
<b>Grand FTE Total:</b>	<b>6.9</b>