Acidification in Cropland Soils – Depth Matters

Dr. Mark Liebig, USDA-ARS Research Soil Scientist

In the northern Great Plains, surface sampling depths of 0-6 or 0-8 inches are suggested for testing soil pH. Soil acidification, however, can be most pronounced near the soil surface. This is especially the case on croplands where no-tillage is practiced and N fertilizers are surface applied.

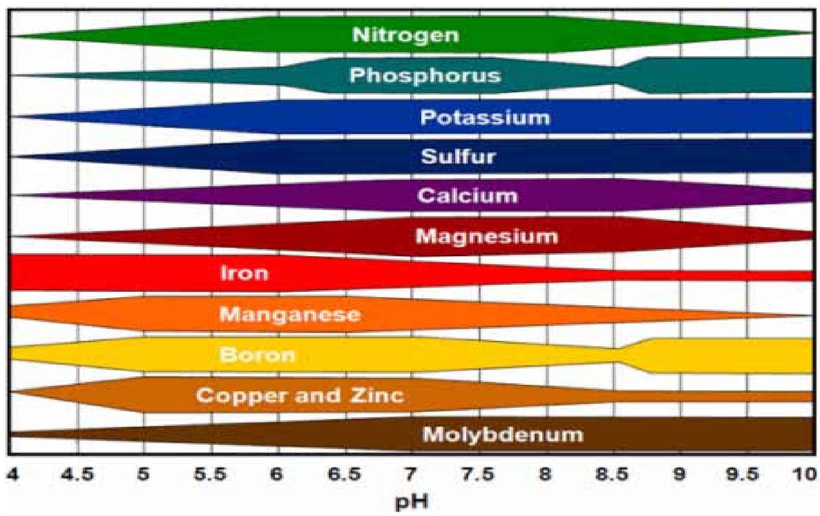


Figure 1. Relative nutrient availability at different pH values (after NRCS, 1993).

To evaluate sampling depth effects on soil pH, researchers at the USDA-ARS Northern Great Plains Research Laboratory quantified soil pH change in two long-term dryland cropping studies at the Area IV SCD Cooperative Research Farm. Soils were sampled at multiple depths in both studies for more than 15 years, allowing for evaluation of pH change at surface (0-3 inch) as well as deeper (0-6 and 0-12 inch) depths.

Significant differences existed between sampling depths for both final soil pH and change in pH (ΔpH) in both experiments (Table 1). In the majority of cases, all three sampling depths were significantly different than each other for both pH metrics examined. Final pH values were higher (and pH changes smaller) as sampling depth increased.

Implications for soil sampling were evident from the evaluation. If the regionally suggested depths for fertility testing were used for soil pH, pH readings were likely to be confounded (increased), as acidification was most pronounced at the soil surface.

Soil acidification can affect herbicide persistence, decrease nutrient availability, and contribute to metal toxicity, all of which can compromise crop production (Fig. 1). Potential negative outcomes from low soil pH underscore the importance of mitigating negative impacts of surface acidification through efficient lime application. Applications directed to specifically address acidification in near-surface soil depths will foster more efficient use of liming materials, as recommendations encompassing deeper soil depths contribute to higher application rates. Additionally, recommendations mitigating soil acidification based on measurements at near-surface depths will detect potential problems earlier than if

continued on page 9

In this issue:

Changes and Opportunities

Drs. John Hendrickson, Dave Archer, Mark Liebig, Acting Research Leaders

The past six months have been a period of change and opportunity for the Northern Great Plains Research Laboratory. One of the biggest changes is reflected in the Research Leader Update byline. Matt Sanderson, who had been the Research Leader for almost 6 years, retired on August 31. Matt has returned to State College, Pennsylvania. Currently, Dave Archer, John Hendrickson, and Mark Liebig are serving details as Acting Research Leader.

In addition to Matt's retirement, Lori Wanner, our long-term IT specialist retired in January 2017. Lori had been in Federal service for 32 years and will be missed. However, Travis Gregurek joined our staff last year and will do an excellent job of providing IT assistance to NGPRL. Our maintenance staff also underwent changes. Duane Krein, the Maintenance Mechanic Leader, and Roland Milhulka, our Laborer, both retired last year. Mike Eberle is now the Maintenance Mechanic Leader and Joe Sullivan has filled the Laborer position.

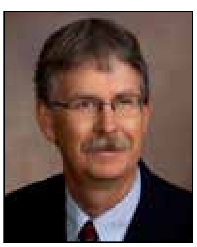
In addition to changes to our permanent staff, there has been an expansion in our capacity to perform research for targeted projects. Both Mark Liebig and Dave Archer have recently hired postdocs. Dr. Derek Faust is helping with the Integrated Crops and Livestock project and Dr. Krishna Pokharel is helping with the oilseed to jet fuel project. Dr. Cannayen has two graduate students, Subhashree Srinivasagan and Sunoj Shajahan, working with the LTAR phenocams, biomass processing, and bale logistics.

Our scientists have been active in developing new relationships. Jose Franco traveled to China and Scott Kronberg traveled to both Ireland and France. The interaction between NGPRL and the French National Institute for Agricultural Research in Toulouse, France has provided opportunities for scientific exchange including, Aymeric Mondiere, a French student intern who is working with Scott Kronberg and John Hendrickson.

NGPRL is also exploring the potential for greater collaboration with the ARS Centers in Fargo and Grand Forks. The Customer Focus Group asked about the possibilities of exploring the Soil-Food-Health continuum and the three ARS locations in North Dakota are uniquely situated to develop this interaction. A major focus for NGPRL in the coming year will be implementation of the Long-Term Agroecosystem Research (LTAR) project, while continuing our other research efforts. Summaries of our research findings, Area IV farm activities, and ongoing research projects are included in this issue and will be a focus of our upcoming winter workshop on February 28th at Bismarck State College.

So, as you can see, there have been changes but also opportunities and new relationships. We look forward to continuing to develop these new collaborations in the year ahead.

NGPRL Research Leader Retires

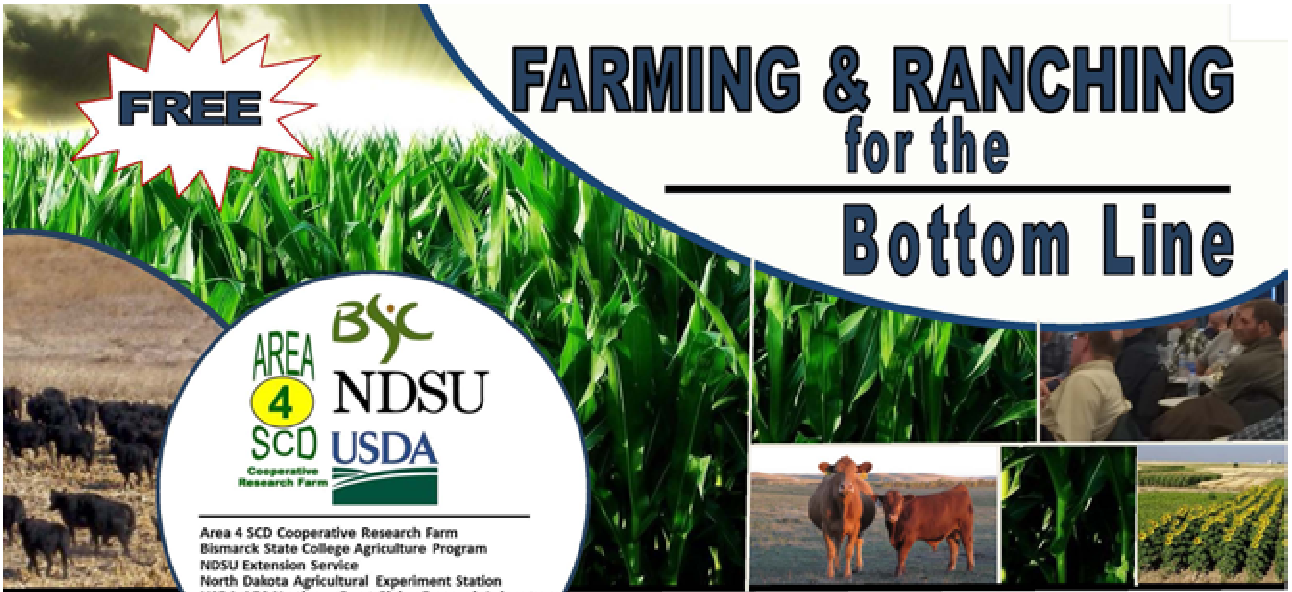


Dr. Matt Sanderson, Northern Great Plains Research Laboratory Research Leader since 2010, retired in August 2016, after 20 years of service with the USDA-ARS.

A native of Willow City, ND, Sanderson earned degrees from NDSU and Iowa State University. After a postdoc position at the University of Missouri, he was on the faculty of Texas A&M for eight years prior to joining USDA-ARS in 1996. As research agronomist and lead scientist at the Pasture Systems and Watershed Management Research Unit at University Park, PA, he did research on forage and pasture management, warm-season grasses for conservation and bioenergy, and grassland ecology. While leading the research at Mandan, his research encompassed rangeland ecology, cropping systems, and bioenergy. At both University Park and Mandan, he worked closely with the NRCS on the grazingland Conservation Effects Assessment Project (CEAP) and Natural Resources Inventory (NRI) effort. At Mandan, he led the effort to establish the lab as a Long-Term Agroecosystem Research (LTAR) network site.

During his career, he published over 150 peer reviewed scientific journal articles and about 200 other publications. Sanderson is a Fellow of the American Society of Agronomy and the Crop Science Society of America, and also received the Merit Award from the American Forage and Grassland Council.

Matt has relocated to Pennsylvania's prime eastern limestone stream habitat to indulge a fly fishing addiction and work with conservation organizations to conserve, improve, and protect such habitat.



FARMING & RANCHING for the Bottom Line

Area 4 SCD Cooperative Research Farm
Bismarck State College Agriculture Program
NDSU Extension Service
North Dakota Agricultural Experiment Station
USDA-ARS Northern Great Plains Research Laboratory
USDA Natural Resources Conservation Service

Online Registration!

Tuesday, February 28, 2017
9:30 AM cst Registration

Bismarck State College
National Energy Center of Excellence, Bavendick State Room
1500 Edwards Ave, Bismarck ND

Alternative Production of Cattle & Other Livestock - More Profitable?
- **Dr. Scott Kronberg**, USDA-ARS Animal Scientist

Water Quality Management - **Dr. Mark Petersen**, USDA-ARS Research Leader, Miles City, MT

Cross Fencing for Aftermath & Cover Crop Grazing - **Mark Hayek**, NRCS State Rangeland Management Specialist & **Dr. Kevin Sedivec**, Interim Director, NDSU Streeter Research Extension Center

Taking Advantage of these Challenging Times - **Taylor Brown**, Northern Ag Network

Weather Crystal Ball - **Daryl Ritchison**, NDSU Extension Meteorologist

Perennials in an Annual Cropping System - **Dr. Mark Liebig**, USDA-ARS Soil Scientist

Innovator's Panel Discussion - **Clay Hollenbeck & Jonathan Marohl, Jay Furher**

Sponsored by:

Use of product or corporation names or trademarks does not constitute official endorsement by the Area 4 SCD Cooperative Research Farm, United States Department of Agriculture or the Agricultural Research Service of any product or service. USDA is an equal opportunity provider and employer.

Register by February 21 at: www.tinyurl.com/2017Farming-Ranching

to join us for this FREE 1-Day seminar! 4.5 CCA CEUs available.

If you are unable to register online, please call the NDSU Extension Service of Morton County at **701-667-3340**.

Assessing and Optimizing Grazinglands

Dr. David Toledo, USDA-ARS Research Rangeland Management Specialist

In the United States, rangelands and pasturelands have traditionally been assessed using different methods and indicators (Fig. 1). When taking into account the dichotomy in grazingland terminology, it is important to note that for some parts of the United States, and many parts of the world, the difference between rangelands and pasturelands is less clear and land considered a pasture to some might be considered an intensively managed rangeland to others. The most commonly used assessment protocol on US rangelands is the Interpreting Indicators of Rangeland Health assessment, while pasturelands are usually assessed using the Pasture Condition Score system. At the NGPRL we have developed an improved grazingland assessment protocol that is applicable to range and pasturelands that highlights the complementarity of both assessment approaches. This improved assessment and monitoring protocol allows evaluators to assess site conditions and to make interpretations regarding management based on site-specific attributes.

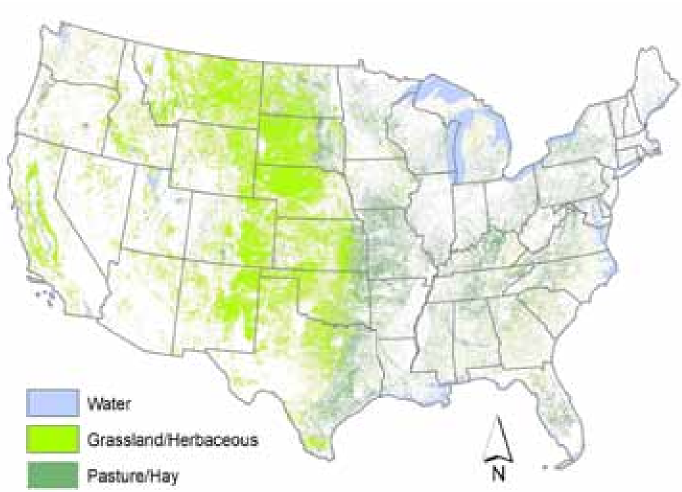


Figure 1. The largest area of grazingland in the United States occurs west of the 100th meridian, in water-limited rangelands. The eastern portion of the country, where water is not a limiting factor, contains substantial areas of improved pastures. Together, these grazinglands represent a substantial proportion of agricultural lands in the United States.

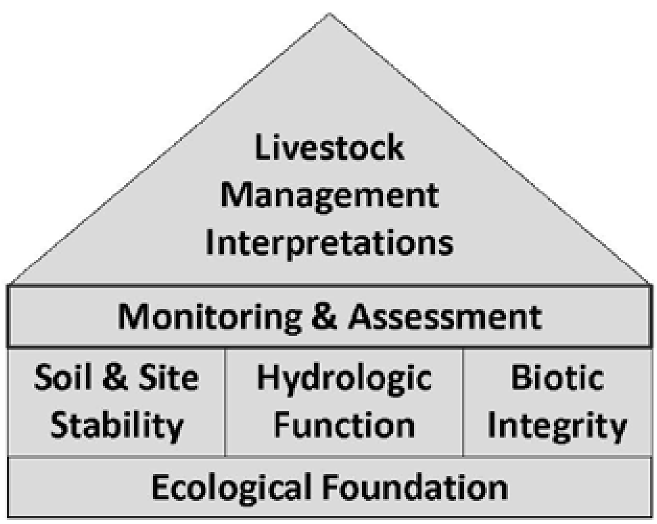


Figure 2. Foundational ecological attributes that contribute to livestock carrying capacity and livestock management interpretations.

Standardized grazingland assessment and monitoring protocols based on ecological and land management principles will ultimately improve national level assessments and will provide a valuable and efficient tool for assessing, managing, and monitoring grazinglands.

The integrated grazingland assessment approach expands on the strengths of previous methods to provide a detailed assessment of the ecological attributes of an area and assess how an area is being managed. For this, the integrated approach is based on attributes of rangeland health as well as an attribute related to grazingland management. These foundational attributes include soil and site stability, hydrologic function, biotic integrity, and livestock carrying capacity (Fig. 2). These attributes contribute to the primary ecosystem service provided by grazinglands, that of forage/fodder production, and to additional services such as sequestration of soil carbon, nutrient cycling, and prevention of soil erosion.

Management interpretations based on these attribute are based on the ecological potential of a site. The baseline potential is based on climatic, topo-edaphic, and ecological factors, which are included in Ecological Site Descriptions. However, this potential can be exceeded for livestock management purposes through the use of conservation practices and other agronomic management techniques. Assessing the potential for livestock production of a site and the capacity to increase that production based on site-specific attributes provides a way of realistically optimizing management based on a site's ecological potential. Our approach allows evaluators to determine management actions that are likely to result in cost effective enterprise efforts that will result in improved grazingland health and increased carrying capacity.

David Toledo 701.667.3063 david.toledo@ars.usda.gov

In a Price Challenged Economy, Thinking 'Entrepreneurially' Can Be of Financial Benefit

By RYAN CROSSINGHAM Farm & Ranch Guide Assistant Editor

Scott Kronberg, research animal scientist, USDA-Agricultural Research Service, Northern Great Plains Research Laboratory, encourages livestock and crop producers throughout the region to focus on net rather than gross profit.

He suggests they start thinking more like entrepreneurs and look for ways that they can evolve into producing unique products, rather than produce only the standard crops and livestock, which can frequently have prices on commodity markets that are too low to produce enough net profit.

"The prices paid for commodity crops are generally low and the prices paid for commodity cattle have come down also," said Kronberg. "There is too much production of commodity crops and livestock and too little production of unique crops and livestock."

Marketing of those unique products derived from special crops and livestock is lacking as well, according to Kronberg.

For farmers and ranchers, changing a mindset that they have been operating under for years, or even as long as the family farm has been in business, can be a challenge.

"Many challenges come with changing one's approach to crop and/or livestock production, but one must keep in mind the 'no pain, no gain' concept," he said. "Is it too hard to find that niche? What is 'too hard' varies from person to person, so it may be too hard for some people, but not too hard for others."

Kronberg said there are various books and courses available to help producers looking to transition their operation toward being more entrepreneurial.

"They have to be willing to learn and apply new approaches and be willing to be persistent as they grow and adapt to a new approach for doing business," he said.

First, it starts with evaluating what they as a producer can produce, and what products are viewed as unique or valuable to the marketplace. As an example, Kronberg suggested a producer could produce crops or cattle with more specific types of healthy fatty acids and/or minerals.

Secondly, Kronberg said producers must develop proper marketing skills to get their products out and known by a lot of people.

Examples of entrepreneurial operations include Brown's Ranch near Bismarck, ND (Gabe and Paul Brown); Bessy's Best in Sterling, ND, and Wheat Montana in Three Forks, MT. Kronberg said these are just a few of many businesses that are examples of farming and ranching operations -- that because they are more entrepreneurial, they are less sensitive to ag commodity prices.

Brown's Ranch practices holistic management and strives to solve problems in a natural and sustainable way. With an intent to improve soil health as a priority, they have no-till farmed since 1993. Their diverse cropping strategy includes cover and companion crops. They have also eliminated the use of all synthetic fertilizers, fungicides and pesticides on their crops. These steps and others have resulted in increased production, net profit and higher sustainability.

Bessy's Best, owned and operated by Blaine and Kathy Goetz, discovered a niche market for their all-natural dairy products. They milk 120 Holstein cows twice a day and all their milk is processed right on the farm to make a number of dairy products. They run a small processing plant where they sanitize everything

continued on page 11

ARS Scientists Eye Management Impacts on Soil Inorganic Carbon

Drs. Jonathan Halvorson and Mark Liebig, USDA-ARS Research Soil Scientists

After 18 years of a long-term study, conducted at the USDA-ARS Northern Great Plains Research Lab near Mandan, ARS scientists observed a general trend of increasing soil C, but did not detect significant differences among the various crop sequences. They concluded that various cropping strategies could increase soil organic matter (Halvorson et al., 2016). In addition to organic forms of soil C, the scientists also noted significant amounts of inorganic-C present at depth together with a trend of increasing pH (Fig. 1). Because the pH scale is logarithmic, the pattern they observed in the research plots showed the soil was 1000 times more acidic near the surface than at 4 feet of depth. Not only was the change of pH large, but it also traversed across a critical range; from acidic conditions (< pH 7) near the surface to alkaline conditions with depth. Associated with this pattern was a clearly apparent change in the distribution of organic and inorganic forms of C in the soil.

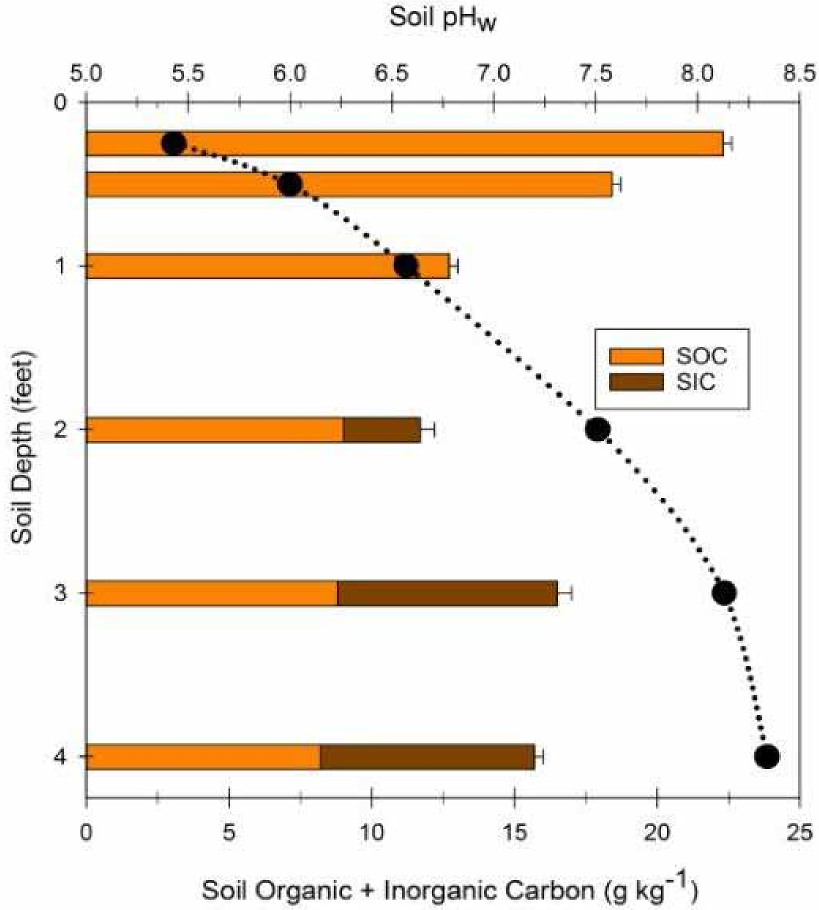


Figure 1. Average concentrations of soil organic (SOC) and inorganic (SIC) carbon as a function of depth and soil pH.

Organic-C in soil originates from plant inputs while inorganic-C results from weathering of the soil parent material or from reactions of soil minerals with atmospheric CO_2. On research plots, total soil C in the top 4 feet averaged about 69% organic C and 31% inorganic-C (carbonates). However, organic-C was the dominant form near the soil surface, where the pH was relatively low, accounting for 100 and 81% of the total soil carbon at the 0-1 and 1-2 foot depths, respectively. However, at depths below about 2 feet, where pH was higher, both organic and inorganic forms of C were present in about equal proportions. When added to organic-C, the inorganic-C increased estimates of total standing stocks of soil C from 114, 156, and 196 Mg ha^{-1} to 126, 209, and 286 Mg ha^{-1}, in the surface 2, 3, and 4 feet respectively. Importantly, the lowest amounts of total C were found to occur at about 2 feet depth suggesting a management critical zone where inputs of organic-C were relatively small and losses of inorganic-C were relatively large.

The impact of different management strategies on pH and organic and inorganic-C in soil requires further study because total soil C may be more responsive to different crop sequences than organic-C alone (Fig. 2). Management of organic-C in soil is tied to the balance between inputs from crop plants or manure and losses due to soil microbial activity. Management of inorganic-C is linked to soil pH and emphasizes retention of existing pools because the rate of its formation is relatively slow compared to the rate of potential losses. Dissolution of inorganic-C occurs at a soil pH of less than about 7, but may not occur as a gradual response to decreasing pH. Instead, there may be a critical threshold of pH below which dissolution occurs rapidly. In North Dakota this critical pH may vary with depth and soil characteristics, and vary with location.

A growing appreciation of the implications of changing patterns of soil pH with depth, together with its link to management practices, has led to new research questions for NGPRL scientists, (Reeves and Liebig, 2016). These require studies

continued on page 7

 continued from page 6

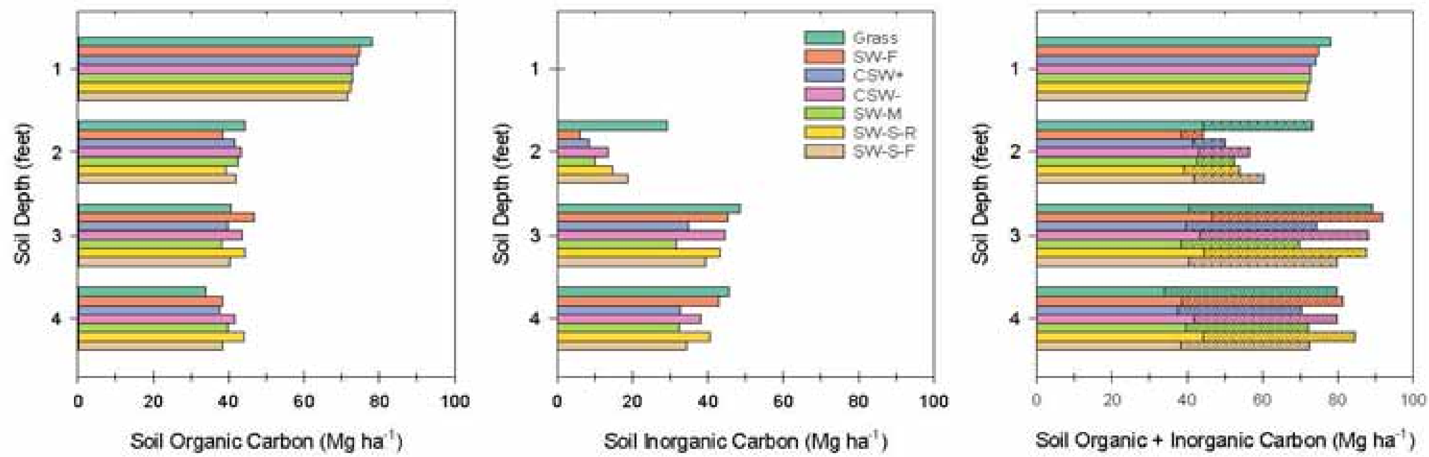


Figure 2. Distribution of organic, inorganic, and total soil C as a function of depth. Treatment averages are presented on an equivalent mass basis for grass (Grass, n=3), spring wheat–fallow (SW–F, n=12), continuous spring wheat with crop residue left on the soil surface (CSW+, n=6), continuous spring wheat with crop residue removed (CSW−, n=6), spring wheat–millet (SW–M, n=12), spring wheat–safflower–rye (SW–S–R, n=18), and spring wheat–safflower–fallow (SW–S–F, n=18).

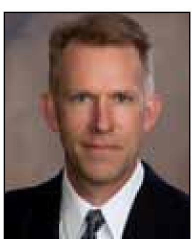
to detect subtle changes in patterns of soil pH and their effects on soil functions particularly fertility and C sequestration. Such basic information, in turn, must be linked to knowledge of those management practices that affect soil pH in both the short- and long-term. In addition, the consequences and possible mitigation of the less manageable drivers of pH change such as the projected patterns of increased temperature and moisture need to be considered. Another important property, related to pH and affected by soil C, is buffering capacity, a measure of soil ecosystem resilience. Little is currently known about how buffering capacity in managed soils has changed historically or in response to agricultural management.

Halvorson, J. J., M. A. Liebig, D. W. Archer, M. S. West, and D. L. Tanaka. 2016. Impacts of crop sequence and tillage management on soil carbon stocks in South-Central North Dakota. Soil Science Society of America Journal 80: 1003-1010.

Reeves, J. L., and M. A. Liebig. 2016. Depth Matters: Soil pH and dilution effects in the northern Great Plains. Soil Science Society of America Journal 80: 1424-1427.

Jonathan Halvorson 701.667.3094 jonathan.halvorson@ars.usda.gov

Recognition



Dr. Mark Liebig, Research Soil Scientist at the Northern Great Plains Research Laboratory, was selected as an Outstanding Reviewer of the *Journal of Environmental Quality* in January 2017.

Dr. David Toledo, Research Rangeland Management Specialist at the Northern Great Plains Research Laboratory, was elected North Dakota Director for the Northern Great Plains Section of the Society for Range Management.

Feel free to pass on this issue of Northern Great Plains Integrator to others interested in agricultural research in the northern Great Plains. Northern Great Plains Integrator is published and distributed by the USDA-ARS, Northern Great Plains Research Laboratory, PO Box 459, Mandan, ND 58554. Use of material in this publication may only be allowed with the consent of the author. The United States Department of Agriculture prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital and family status. Mention of trade or manufacturer names is provided for information only and does not constitute endorsement by USDA-ARS. To be added to our mailing list, request a copy through our website or contact editor: Cal Thorson, Technical Information Specialist, USDA-ARS Northern Great Plains Research Laboratory, PO Box 459, Mandan, ND 58554. Office:701 667-3018 FAX:701 667-3077 Email: cal.thorson@ars.usda.gov

Planting Perennials can Help Provide Ecosystem Services

By RYAN CROSSINGHAM   Farm & Ranch Guide Assistant Editor

It's time to reconsider perennials in rain-fed cropping systems, according to M.A. Liebig, Research Soil Scientist, USDA-Agricultural Research Service, Northern Great Plains Research Laboratory.

Liebig said despite land use projections suggesting a limited role for perennials in conventional crop production systems, cropping systems are increasingly looked upon to provide ecosystem services beyond the provision of food, feed, fiber and fuel.

He believes supporting, regulating, and cultural ecosystem services both directly and indirectly benefit human welfare, and should be included within a larger rubric of expectations for agricultural landscapes.

Furthermore, those expectations complement the multiple functions of perennials, which include soil fertility enhancement, targeted remediation, wildlife habitat or water quality protection.

Combined with the anticipated changes in climate in most regions of North America, the important roles of permanent ground cover is further highlighted.

Liebig noted agroecosystems in the northern Great Plains are currently undergoing a transition toward more intensified production, mostly due to climate-driven shifts with greater early-season water availability and an extended growing season.

"Our growing conditions have slowly become more adaptable to warm-season crops, plus seed companies have invested significant resources to adapt these crops to our region," said Liebig. "It's tough to pinpoint a start to the transition, but the wet cycle beginning in the early 1990s is often referred to as the 'tipping point' toward wetter and warmer growing seasons in our region."

Liebig said this transition to a wetter, warmer and more variable climate will increase the susceptibility of soil degradation on agricultural lands through increased rates of erosion, nutrient loss and salinization.

Adding perennial grasses, and the permanent ground cover they can provide, can serve as a buffer to climate-induced stresses while concurrently improving soil conditions to facilitate agroecosystem resilience, according to Liebig.

Which perennial is a good place to start? Liebig suggests alfalfa is a good choice.

"It has a proven track record of good production in the area, and you can often seed it with a nurse crop to get a small economic return during the establishment year," he said.

For growers looking to implement perennials in their operation, Liebig said identifying a market for the forage (i.e. nearby dairy, cattle producer, etc.) is the place to start.

"Once you have a buyer, review your land base to determine where a perennial makes the most sense to plant," he said. "While all cropland can benefit from inclusion of perennials, there can be significant benefits to overall farm sustainability if the perennials are placed on strategic parts of the landscape."

Liebig also noted, though it goes against prevailing trends, returning livestock back to the farm will also help when implementing perennials.

"Returning livestock back to the farm offers a clear path for a greater role for perennials on cropland," he said.

Mark Liebig 701.667.3079 mark.liebig@ars.usda.gov

Acidification in Cropland Soils – Depth Matters *continued from page 1*

recommendations were based on deeper soil depths.

In summary, findings from this evaluation suggest the regionally-recommended sampling depths of up to 8 inches may be too deep for early detection of surface acidification. Adoption of surface sampling depths 3 inches (or less) is recommended for testing soil pH in the northern Great Plains.

Crop Rotations and Soil Acidification

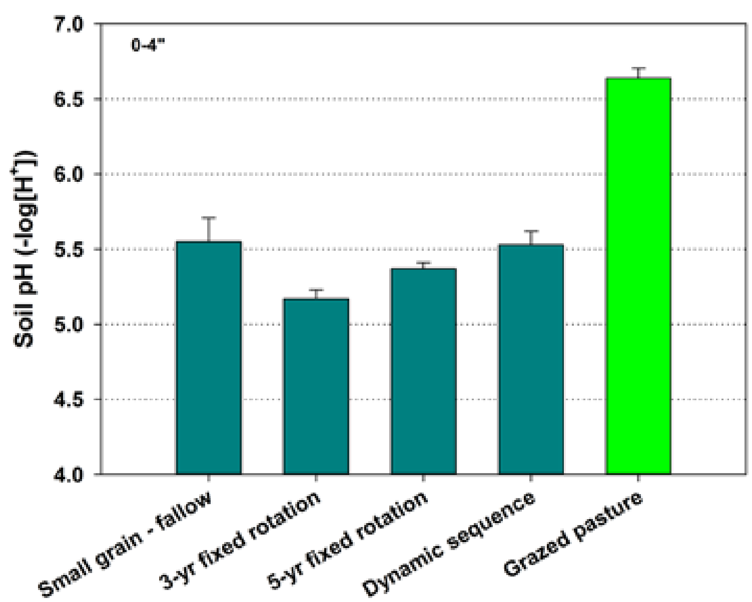
Outcomes from a complementary study on the Area IV farm found cropping sequence had differential impacts on soil pH in near-surface depths. In the study, soil pH was evaluated in small grain – fallow and three continuously cropped rotations (three year, five year, and dynamic). Soil pH was also evaluated in a nearby grazed pasture with the same soil type as the crop rotations.

Soil acidification was found to be greater in the three year rotation compared to the small grain – fallow and dynamic rotations. Acidification is expected to be greater where N is applied each year compared to crop-fallow, where N is applied biannually. Decreased acidification in the Dynamic versus the 3-yr rotation was likely the result of differences in applied N over time. Soil pH in cropped sites was over one pH unit lower than under grazed pasture.

Table 1. ANOVA results for comparisons of final pH and ΔpH by sampling depth within fertilizer N and tillage treatments for two long-term cropping experiments at the Area IV SCD Research Farm near Mandan, North Dakota. Values for final and ΔpH represent mean ± 1 standard error. Different letters represent significantly different values among the three sampled depths (adapted from Reeves and Liebig, 2016)

Depth (inch)	Final pH	ANOVA *F* (*P*)	Tukey HSD	ΔpH	ANOVA *F* (*P*)	Tukey HSD
Conservation Tillage-Cropping Systems Experiment						
67 kg N ha^{-1} yr^{-1}; Minimum tillage						
0-3	5.97 ± 0.07		A	-0.37 ± 0.09		A
0-6	6.16 ± 0.08	8.54 (0.0019)	AB	-0.20 ± 0.10	4.13 (0.0307)	AB
0-12	6.47 ± 0.11		B	0.01 ± 0.08		B
67 kg N ha^{-1} yr^{-1}; No-tillage						
0-3	6.00 ± 0.05		X	-0.42 ± 0.06		X
0-6	6.20 ± 0.06	16.59 (<0.0001)	X	-0.18 ± 0.08	5.94 (<0.0080)	XY
0-12	6.49 ± 0.07		Y	-0.08 ± 0.07		Y
101 kg N ha^{-1} yr^{-1}; Minimum tillage						
0-3	5.69 ± 0.07		A	-0.71 ± 0.07		A
0-6	6.00 ± 0.07	27.58 (<0.0001)	B	-0.40 ± 0.06	16.93 (<0.0001)	B
0-12	6.44 ± 0.08		C	-0.13 ± 0.08		C
101 kg N ha^{-1} yr^{-1}; No-tillage						
0-3	5.72 ± 0.06		X	-0.82 ± 0.08		X
0-6	6.03 ± 0.06	29.63 (<0.0001)	Y	-0.47 ± 0.07	16.78 (<0.0001)	Y
0-12	6.39 ± 0.07		Z	-0.24 ± 0.06		Y
Soil Quality Management Experiment						
67 kg N ha^{-1} yr^{-1}; Minimum tillage						
0-3	5.54 ± 0.07		A	-0.98 ± 0.06		A
0-6	5.78 ± 0.06	28.11 (<0.0001)	B	-0.64 ± 0.04	31.44 (<0.0001)	B
0-12	6.20 ± 0.06		C	-0.44 ± 0.04		C
67 kg N ha^{-1} yr^{-1}; No-tillage						
0-3	5.37 ± 0.04		X	-1.14 ± 0.07		X
0-6	5.64 ± 0.03	73.63 (<0.0001)	Y	-0.78 ± 0.04	28.75 (<0.0001)	Y
0-12	6.06 ± 0.04		Z	-0.58 ± 0.05		Z

Reeves, J.L., and M.A. Liebig. 2016. Depth matters: Soil pH and dilution effects in the northern Great Plains. Soil Sci. Soc. Am. J. 80:1424-1427.



Crop diversity effects on pH at 0-4" for long-term cropping treatments near Mandan, ND (Liebig et al., 2014).

Mark Liebig 701.667.3079 mark.liebig@ars.usda.gov

Using Fire and Herbicides to Control Kentucky Bluegrass

Dr. John Hendrickson, USDA-ARS Research Rangeland Management Specialist

Many people are familiar with Kentucky bluegrass because it is one of the most common lawn grasses in the northern United States. However, on rangelands in North Dakota, it has rapidly increased in the last 30 years (Fig. 1). The invasion of Kentucky bluegrass onto rangelands is not just limited to North Dakota but has occurred throughout the northern Great Plains (Fig. 2).

The rapid spread of Kentucky bluegrass caught the eye of range scientists in North Dakota and they began to look for control strategies. The Northern Great Plains Research Laboratory, NDSU and the US Forest Service collaborated on research that evaluated combinations of fire and herbicides as potential control strategies on the Sheyenne National Grasslands.

Treatments included a fall burn (October 2005) or a spring fire (April 2006) (Fig. 3) and the application of either glyphosate (Roundup©) or imazapic (Plateau©) (Fig. 4). On sites that were burned in the fall, herbicide treatments were applied the following spring after the burn (May 2006). On spring burned sites, herbicide treatments were applied in the fall prior to the burn (October 2005). Besides the plots that were burned and sprayed with herbicide, there were also plots where the only treatment was a spring burn, plots that only had a fall burn, and also untreated controls. Each treatment was applied to sites with either LOW, MODERATE or HIGH levels of Kentucky bluegrass abundance.

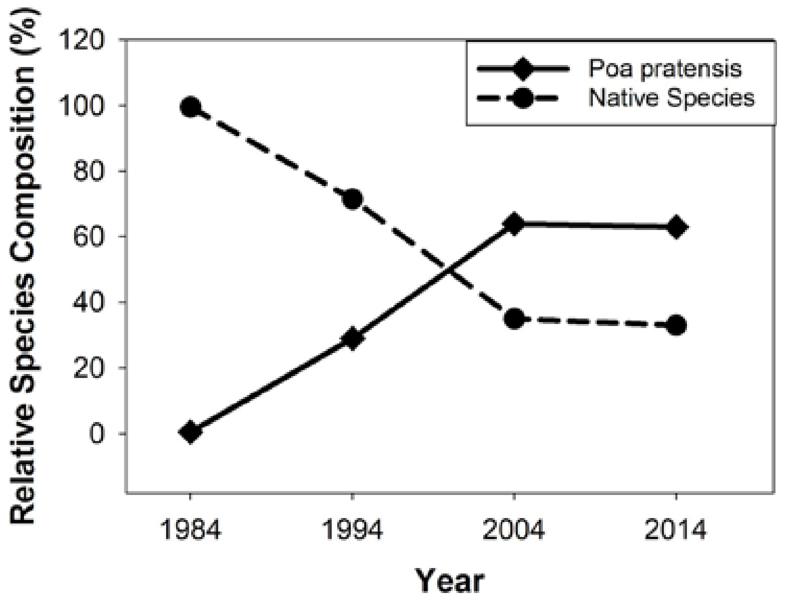


Figure 1. Change in percent Kentucky bluegrass (Poa pratensis L.) and native species in the relative species composition at a long-term (98 years) lightly grazed pasture at Mandan, North Dakota. Data modified from Printz and Hendrickson (2015).

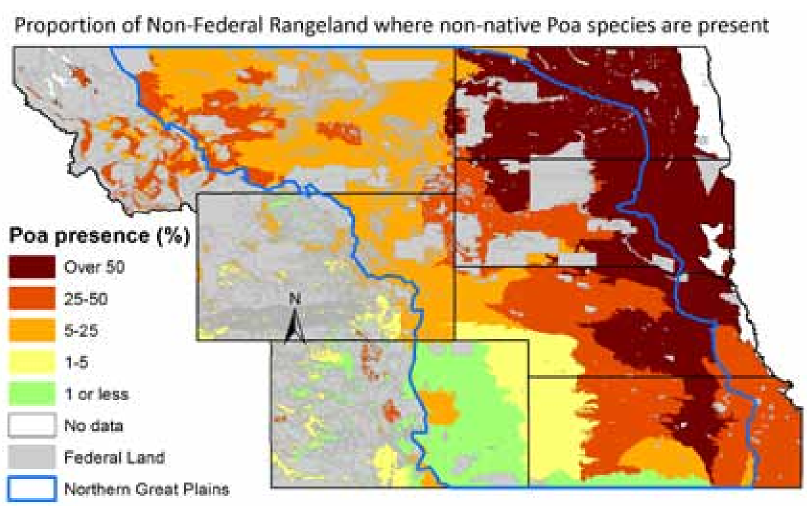


Figure 2. Proportion of rangeland with Kentucky bluegrass based on USDA-NRCS National Resources Inventory (NRI) data between 2003-2006. Percentages refer to percent of acres with Kentucky bluegrass present within a Major Land Use Area polygon. Figure fron Toledo, et al. (2014)

Figure 5 shows treatment results in both 2006 and 2007 for the site that had a high level of Kentucky bluegrass abundance. Prior to applying the treatments (summer 2005), Kentucky bluegrass made up 91% of the species composition on this site. However in 2006, the fall burn followed by a spring application of glyphosate (Fall + Glyph) treatment resulted in native grass increasing to over 50% of the species composition while introduced grasses (primarily Kentucky bluegrass) decreased to less than 20% of the species composition. While treatment effects diminished in 2007, native grasses still made up the majority of the species composition on this heavily invaded site.

There are increased concerns about how management can impact forb species which are critical for pollinators. There were no differences in forb abundance between any of the treatments, including the

continued on page 11

Using fire and herbicides to control Kentucky Bluegrass *continued from page 10*

Figure 3. US Forest Service burn crew burning research plots on Sheyenne National Grasslands near Lisbon, ND.

Figure 4. NGPRL technician spraying research plots on Sheyenne National Grasslands near Lisbon, ND.

untreated control, on the high site. While there were some treatment differences on the moderate site, these disappeared after one year.

The information gained from this research indicates that burning plus herbicide can be a powerful tool for managing invasions on rangelands. However, the effects of these treatments are short-lived.

Land managers need to look at changes in species composition caused by these treatments as opportunities for additional management. Grazing, burning, hay, or additional herbicide application may be needed to continue the effectiveness of these treatments.

John Hendrickson 701.667.3015 john.hendrickson@ars.usda.gov

 This research was funded by a grant from the US Forest Service.

Printz, J.L. and Hendrickson, J.R., 2015. Impacts of Kentucky bluegrass invasion (Poa pratensis L.) on ecological processes in the Northern Great Plains. Rangelands 37:226-232.

Toledo, D., Sanderson, M., Spaeth, K., Hendrickson, J. and Printz, J., 2014. Extent of Kentucky bluegrass and its effect on native plant species diversity and ecosystem services in the northern Great Plains of the United States. Invas. Plant Sci. Manage. 7:543-552.

In a Price Challenged Economy, Thinking ‘Entrepreneurially’ Can Be of Financial Benefit

Continued from page 4

between all processes with a bleach-like solution. Their milk goes into cooling tanks and is then separated. It is pasteurized at a low heat, creating ultra-pasteurized milk.

Wheat Montana has been farming and milling in southwest Montana for three generations, growing their grain sustainably and milling it just down the road, meaning they can guarantee their products are top quality, healthy and farm fresh. Whether their customers are interested in flour, bread, specialty grains, pancake mixes, cereals, bakery items or even a homemade deli sandwich, their products are both healthy and fresh.

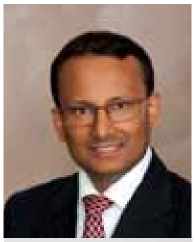
“These three businesses are just examples, that neither I nor the USDA-Agricultural Research Service are endorsing, but nonetheless are good examples of farm-based business that are producing some unique products and selling them directly to consumers,” said Kronberg.

Finally, he preaches patience and persistence to anyone looking to make changes to their operations.

“To be successful, entrepreneurs with unique crops and/or livestock will require serious effort and may be considered unusual by one’s neighbors. A patient and persistent attitude will probably be needed, as well as a good sense of humor and willingness to do things that are at least a little different from what one’s neighbors are doing in agriculture,” Kronberg concluded.

Scott Kronberg 701.667.3013 scott.kronberg@ars.usda.gov

Staff Changes



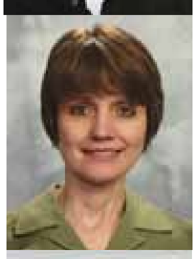
Dr. Krishna Pokharel, joined the staff of the Northern Great Plains Research Laboratory as a Post Doctoral Agricultural Economist in October 2016 working on the oilseed to jet fuel project. He earned his PhD in Agricultural Economics at Kansas State University.

Subhashree N. Srinivasagan joined the NSDU Agricultural and Biosystems Engineering Department working with Dr. Igathi Cannayen in December 2016. She is originally from India. Her master's research focuses on in-field biomass bale logistics including determining efficient bale stack location before transporting the bales to the field outlet, the areas impacted by wheel traffic during harvesting, baling, collecting, and transport and rain effect on bales. She is also working on the phenocam application for detecting crop stress and productivity in the LTAR Project.

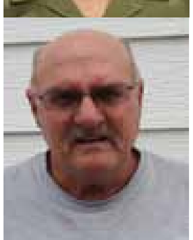
Dr. Derek Faust joined the staff of the Northern Great Plains Research Laboratory as a Post Doctoral Research Biologist in August 2016. He is focusing on the integrated systems USDA-NIFA project. He recently completed his PhD at Mississippi State University where he evaluated effects of organic carbon amendments on nitrogen removal in agricultural drainage ditches.

Sunoj Shajahan is a student in the NDSU Agricultural and Biosystems Engineering Department. Originally from India, he joined the NDSU research group at NGPRL in December 2016. His PhD research is on developing algorithms to monitor plant health using the phenocam. He will be working on the NDSU experiments on phenocam, color calibration, developing new phenological indices on wheat, and biomass estimation using image processing techniques. He will also be involved in applications of image processing, and remote sensing in agriculture.

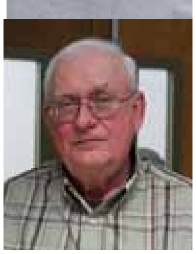
Joe Sullivan joined the staff as Laborer in January 2017. Joe previously worked with the U.S. Department of Education and U.S. Department of Labor. He is a native of the Bismarck-Mandan area and holds a business management degree from UND. Joe and his wife, Stacey, have five grown children and five grandchildren.



Lori Wanner, USDA-ARS Information Technology Specialist, retired from the Northern Great Plains Research Laboratory in January 2017, after 32 years of Federal service. Lori will be summer/winter migrating between North Dakota and Arizona in retirement.



Roland Mihulka, Laborer, retired from the Northern Great Plains Research Laboratory in July 2016 after 14 years of Federal service. Roland will be summer/winter migrating between North Dakota and Arizona in retirement.



Duane Krein, Maintenance Mechanic Leader, retired from the Northern Great Plains Research Laboratory in March 2016, after 28 years of Federal service. Duane is enjoying spending time with family and friends.