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Perennial Forages Important for Improving Soil Health

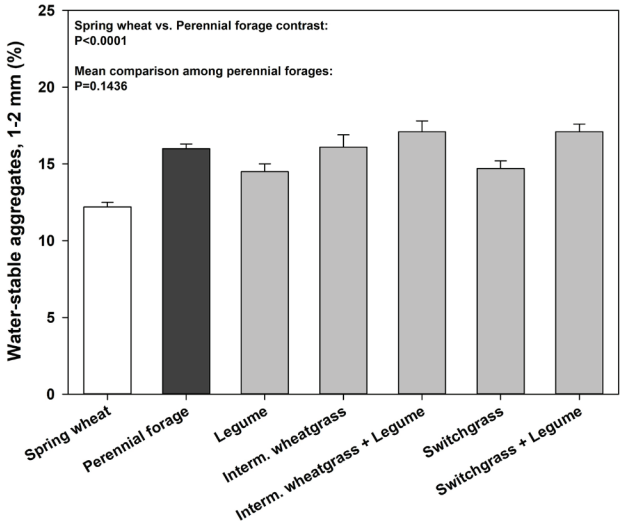
Dr. Mark Liebig

Adding perennial forages in annual cropping systems can offer significant benefits to agricultural landscapes. In addition to providing feed for livestock, perennial forages improve nutrient and water cycling, increase wildlife habitat, and provide novel educational and recreational opportunities for people of all ages.

Some landscape-scale benefits associated with perennial forages are due to changes in soil properties. Under perennials, limited soil disturbance and increased organic matter inputs from roots lead to changes in soil properties which can improve soil health.

Despite this logical connection, management guidance for producers regarding use of perennial forages in annual cropping systems is lacking. Specifically, the length of time needed for soil health improvements to occur under perennial forages is unclear. In part, this is due to differences in forage types and productivity across regions.

To address this need, NGPRL scientists conducted a multi-year study to measure changes in soil properties under perennial grasses, legumes, and grass-legume mixtures at an experimental site near Mandan, North Dakota. Soil measurements were made over a five-year period, and included continuous spring wheat as an annual crop control.



Relative to continuous spring wheat, perennial forages reduced soil acidification and soil bulk density, and increased aggregate stability (Fig. 1) and a moderately-degradable pool of soil organic matter.

Results suggested that soil responses to perennial forages occurred as soon as two years after forage establishment, but peaked four years after establishment.

Among perennial forages, intermediate wheatgrass alone or mixed with alfalfa reduced soil bulk density and increased moderately-degradable organic matter compared to alfalfa, but such differences took four to five years to be detected.

Outcomes from the study suggested perennial forages maintained or improved near-surface soil health, but effects were subtle and were generally slow to occur. Results also showed the importance of strategic management (e.g., no-till, cover crops, increased residue retention) to ensure improvements in soil heath are preserved between perennial-annual transitions

Adapted from Liebig, M.A., J.R. Hendrickson, J. Franco, D.W. Archer, K. Nichols, and D.L. Tanaka. 2018. Near-surface soil property responses to forage production in a semiarid region. Soil Sci. Soc. Am. J. 82:223-230.

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Message from Dave

Dr. David Archer, Research Leader

This growing season has rapidly changed from initial cold/dry conditions to warm/wet conditions. Early concerns about drought and delayed planting have turned to cautious optimism as crops have entered the rapid growth phase, but recognizing that the same weather patterns which brought us welcome rains can also bring damaging weather. While the changes within this season have been dramatic, the changes between last season and this season are even more dramatic. At this time last year, we had made the decision not to harvest the corn for grain in our Integrated Crops-Livestock study, but rather to use it for grazing. This year, we are planning for a normal grain harvest, with hopes of above-average yields. This variability presents a challenge for agricultural producers in the Northern Great Plains in making the best management decisions taking into account changing conditions. It also presents a challenge for researchers in developing systems and tools for managing production in these variable conditions, and also, in measuring impacts of management that occur under widely varying conditions.

That is why much of the research that we do at the NGPRL is long-term. This allows us to look at the performance of production systems and to develop a better understanding for how they perform under a wide range of situations. Benefits, include identifying systems that are more resilient to varying conditions and systems that allow for flexible management in adapting to changing conditions. The Integrated Crops-Livestock situation that I described earlier is a good example. One benefit of this system is the flexibility to harvest corn as a grain crop for market or to graze it for forage depending on the conditions and the most valuable use in that situation. Long-term research also allows us to look at changes that occur over time that may not be initially apparent given year-to-year variability. Examples of this research include articles in this issue by Dr. Liebig on perennial forages and soil health, and by Dr. Toledo on cool-season invasive grasses. I hope you enjoy this issue of the Integrator, and as always, welcome your questions or feedback.

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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. 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

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South of the Heart River on Highway 6
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Mandan

July 19, 2018
2:00 - 5:30 PM CDT

www.ars.usda.gov/plains-area/mandan-nd/ngprl/

WWW.AREA4FARM.ORG 701.667.3000

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- Remote Sensing and Phenology
- Transitioning to Organic Crops
- NDSU Variety Trials

Examining Farmers' Willingness to Grow and Allocate Land for Oilseed Crops for Biofuel Production

Dr. Dave Archer

The demand for sustainable and secure sources of renewable energy has risen due to higher transportation costs, environmental issues and national security concerns. Numerous countries are searching for renewable and secure sources of energy that reduce greenhouse gas emissions caused by fossil fuels. In particular, a number of initiatives within the airline industry are taking place to enhance the production and use of biofuels. Oilseed crops such as camelina, carinata, and canola have good properties for bio-based jet fuel. Examining alternative sources for biofuels is important to meet the potential demand for biofuel, particularly for the airline industry.

While there are several crops that could be used for producing biofuels, understanding if farmers would grow these crops is crucial for market development. Studying the technical feasibility of oilseed crops in connection to biofuel production is not enough. Production of bio-jet fuel from oilseeds will not be successful unless farmers are willing to grow them.

Research was conducted to determine farmers' willingness to adopt and allocate land for growing non-food oilseeds as bio-energy crops across the western US. The research also focused on identifying factors that increase or decrease willingness to growing these crops.

A mail survey was conducted in three regions of the western US from randomly selected wheat farmers located in 11 states in the western US. This study examined the willingness of farmers to adopt and allocate land for oilseed crops for bio-jet fuel production. From an economic standpoint, farmers decide to introduce oilseed crops in their farming systems when they believe that the expected profit from the new crop is higher than the expected profit without the new crop. At the same time, farmers' who are willing to adopt also consider how much land to allocate for the new crop. During adoption and land allocation decisions, different factors also affect farmers' willingness to grow bioenergy crops.

Results indicated that 58% of sampled farmers were willing to adopt oilseeds as bio-energy crops under favorable contracts, and were willing to grow oilseed crops initially on 160 acres. This compares to previous research showing 61 and 44% of farmers surveyed would be willing to grow annual and perennial bioenergy crops, respectively. Furthermore, these farmers indicated they would be willing to allocate on average 122 and 97 acres for annual and perennial bioenergy crop production, respectively.

Several factors had a significant positive effect on likelihood of adoption. Likelihood of adoption was 21% higher for farmers who had previous experience growing oilseeds, 8.8% higher for self-identified first-adopters, 18% higher if an oilseed crushing facility was nearby, 9% higher for farmers who use no-till, and 6% higher for farmers having a college degree. Conversely, likelihood of adoption was 16.5% lower for risk-averse farmers and 36% less for female farmers compared to male farmers. Also, more experienced farmers were less likely to adopt oilseeds, with a 0.34% decrease for each additional year of experience.

Similarly, the initial area that farmers were willing to allocate to oilseed production was significantly influence by several factors. Reliance on farm income had a positive impact of oilseed adoption, with a 1% increase in the portion of household income coming from farming increasing the allocation of land to oilseed crops by 1.4 acres. Also, although female producers were less likely to adopt oilseeds, if they did adopt oilseeds, they would be willing to initially devote a larger area to oilseed production, 3.4 more acres than male farmers. Factors having a significant negative impact on the initial land allocated to oilseeds included crop-share land rents, the relative profitability of wheat compared to oilseeds, and livestock ownership.

Recommendations to increase the development of oilseeds as a bioenergy crop should consider the above factors. To increase the adoption and supply of oilseed crops for biofuel production, results suggest the following.

• Availability of nearby crushing facilities are important. Nearby availability of crushing facilities increases the chance of market establishment for oilseed crops.

• Farmers with oilseed production experience have a positive influence on the adoption process. This

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Examining Farmers' Willingness to Grow and Allocate Land for Oilseed Crops for Biofuel Production

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may help to create a conducive environment where experienced oilseed producers can share their experience with other farmers.

• When assessing adoption, consideration of land tenure arrangements should be considered. Land rented on a crop-share basis was less likely to be allocated to oilseed production. Involve land owners earlier on in the process to get their buy-in.

• Increasing the profit of oilseed varieties (discovering good varieties, price support etc.) could lessen the opportunity costs of switching to oilseed production. Hence more land could be converted for oilseed production as the opportunity cost of growing oilseeds is reduced.

• A potential supply for oilseed crops for biofuel and bio-jet fuel production is possible, but barriers to market establishment still need to be overcome.

Further research is needed to conduct similar studies in other areas. It is also recommended to determine what favorable contracts for farmers should consist of. A favorable contract is different for different farmers, as well as between farmers and bio-refineries. In this study, willingness to grow oilseed crops were treated as one activity. But there are different types of oilseed crops which are suited to different locations. Further research is then recommended to identify which oilseeds would be optimal for different locations.

Examining farmers' willingness to grow and allocate land for oilseed crops for biofuel production Energy Economics 71 (2018) 311–320 Weldensie T. Embaye, Jason S. Bergtold, David Archer, Cornelia Flora , Graciela C. Andrango, Marting Odening, Jeroen Buysse

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A Potentially Easier Way to Determine Daily Forage Intake of Grazing Cattle for Various Purposes

Dr. Scott Kronberg

If we had a simpler and less expensive way to determine how much forage individual cattle graze each day, more rangeland and cattle managers could obtain this information to use in a variety of ways to improve their management of land and/or cattle. For example, cattle producers and breeders could use the information to help determine which animals to keep and which to cull and scientists could use this information for various research projects. So, what if we could collect a sample of fresh feces from each animal of interest, dry the feces then scan it with a near-infrared spectrometer (NIRS) and use the data output from the scanned feces to develop an equation to accurately predict each animal's daily dry forage intake? Near-infrared spectroscopy is used for many purposes including predicting the quality of forages, grains, oilseeds, and other agricultural products. It has also been used to predict diet quality of grazing cattle, sheep and goats by scanning small samples of their dried feces and entering the NIRS output data into a prediction equation to predict the percentage of crude protein and digestible matter in their diets.

Photo of forage auto-feeders

A prediction equation is developed with pen-fed animals with diets of known forage quality and daily feed intake.

What we plan to do over the next few years is use low-labor auto-forage feeding and measuring equipment with penned cattle to develop prediction equations with fecal NIRS for different types of forage and cattle and determine if we can accurately predict daily forage dry matter intake for individual cattle while they consume different types and qualities of forage.

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Growing Agricultural Knowledge Using Education Outreach

Dr. Derek Faust

Knowledge about agriculture among the general public and youths in the U.S. has been on a worrying decline. Many of us have likely heard of the studies and surveys showing a growing percentage of children think that milk, meat, and produce comes from the grocery store. While we are excited by seeds and agriculture, it takes some creativity to engage parents and their children. In spring 2018, the Northern Great Plains Research Laboratory (NGPRL) participated in two outreach events in the Bismarck and Mandan area.

Staff from NGPRL have participated in the annual Morton County Agriculture Day for many years and contributed to this year's theme of "How to Make a Pizza." We had a seed exhibit in which

kids (and adults) could see and touch seeds (corn, flax, buckwheat, etc.) in a variety of food products (vegetable oils, flour, cereal, etc.). NGPRL has used this activity for several years and it is always popular, but ideas were discussed to change it up or add to the activity for future years. These ideas included seed germination boxes to germination from seed to initial roots and/or box displays showing fibrous vs. tap roots.

Steps for Making a Living Necklace

1. Ensure you have the necessary supplies
    a. Plastic zip lock bag
    b. Cotton ball
    c. String or yarn
    d. Seeds (corn, popcorn, wheat, etc.)
    e. Water
2. Dip cotton ball in water and squeeze most of the water out so that it is not dripping
3. Place wet cotton ball and seed(s) into bag and seal the bag
4. Insert string/yarn through the hole in top of bag and tie to make a necklace
5. Wear necklace
    a. Body warmth and light will help your seeds germinate and grow in 3-6 days

Watch tutorial @ https://agclassroomstore.com/living-necklace-corn-seeds/

NGPRL staff also helped organize and exhibited at the annual Bismarck Earth Day Festival. Continuing with the trend of demonstrating the importance of seeds, Derek Faust (Research Biologist), Anne Horsin (Visiting student from France), and Cal Thorson (Technical Information Specialist) helped kids make seed necklaces. This activity helped them learn what seeds need to germinate compared to what plants need to grow. Corn seeds were placed in a small zip bag with a wet cotton ball, which provided a good location (like soil), water, air, and nutrients for the seed to germinate. Body heat provides the warmth (correct temperature) a seed needs to germinate. This activity was a big hit as both adults and kids alike exclaimed, "That's so cool!"

The biggest outreach event of the year at NGPRL, Friends and Neighbors Day, will be on July 19th and includes field tours, campus presentations/activities, and a children's activity area. For more information on these events or activities, please feel free to contact Cal Thorson at cal.thorson@ars.usda.gov.

Merrill receives Conservation Research Award

Dr. Steve Merrill, USDA-ARS Research Soil Scientist (retired) at the Northern Great Plains Research Lab has been recognized for his professional excellence and achievements by the International Soil and Water Conservation Society with their 2018 Conservation Research Award.

Although Merrill retired in 2006 after 40 years of federal service, he has continued as a collaborator at the lab. He has made significant contributions to soil science and agroecology research spanning from the 1960's to the present. He has made extensive and diverse contributions to basic and applied science that directly support the adoption of soil and water conservation practices globally.

Over the course of his career, Merrill has been a leader or essential team member for a broad array of research projects on topics of mined land reclamation, soil erosion, soil quality, crop water use, and cropping systems design. Using a keen intellect founded on the basic sciences coupled with an inherent creativity to apply measurement technology in novel ways, Merrill has provided critical information over the course of his career needed to sustainably apply conservation practices to agricultural landscapes. In addition to leading a productive research program, Merrill served in multiple advisory roles at state and national levels related to mined land reclamation, water resource management, and wind erosion research. He has given countless presentations in support of using science-based guidance to apply conservation on the land.

Soil Quality and Water Redistribution Influences on Plant Production over Low Hillslopes of Reclaimed Mined Land

Dr. Steve Merrill

Understanding interactions among plant growth, soil quality (SQ), and landscape hydrology can serve to guide management decisions for optimizing ecosystem services on agricultural landscapes.

We applied both SQ assessment and an index of water redistribution to resolve the influence of soil and land factors on plant productivity for mined land reclamation sites in central North Dakota.

At one site near Zap, North Dakota, cool-season forage grasses were more influenced by hillslope water redistribution while spring wheat yield showed influence of SQ and depth in the lower part of the hillslope and water redistribution in the upper part of the hillslope. At the site near Stanton, North Dakota, perennial forages and spring wheat showed similar patterns of growth response, with SQ and depth effects lower on the hillslope and water redistribution effect on the upper part.

Results of this study suggest plant community and soil characteristics on reclaimed, disturbed lands can alter the relative influence of SQ factors and water distribution effects on hillslope production patterns.

This outcome is relevant to not only land managers dealing with reclamation of disturbed lands, but to agricultural producers in general.

A basic part of soils' delivery of ecosystem services is the interaction between plant growth response to soil quality (SQ) factors at point scale and water redistribution effects at hillslope scale.

To study the influence of SQ-indicator properties and water redistribution, we examined hillslope production patterns of perennial forage species and spring wheat, and the relationships of such yield patterns with respread soil depth (RSD), SQ index (SQI) and hillslope wetness from catchment area (HW(a)) within two mined land reclamation

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Soil Quality and Water Redistribution Influences on Plant Production over Low Hillslopes of Reclaimed Mined Land

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experiments in central North Dakota (Zap and Stanton).

At Zap, yield of cool-season forages crested wheatgrass and Russian wildrye increased about 10% with increasing RSD from toeslope to about 10 m upslope, and then declined by greater amounts further upslope.

These hillslope patterns appeared dominated by water redistribution effects, reflecting response of cool-season forages to springtime water availability.

Forage species at Stanton included alfalfa, native grass mix, and crested wheatgrass. Growth of these increased 70% from toe to midslope, and then decreased 20% towards summit, indicating a greater response to RSD and SQ factors downslope and lesser response to water redistribution upslope.

Hillslope patterns of spring wheat seed yields at both sites were similar to those of forages at Stanton, showing greater response to SQ metrics.

Factors likely to be involved in production patterns at Stanton exhibiting greater response to SQ measures than at Zap were, (a) indications that hydraulic conductivity in the mine spoil at Stanton was lower than at Zap, and (b) Stanton had south aspect only, while Zap had north and south aspects. Regressions of perennial biomass yields vs. soil characteristics were consistent with hillslope production results, with positive responses to HW(a) and negative responses to RSD and SQI for forages at Zap, but positive responses to SQ measures for forages at Stanton.

Results indicate that plant community and soil characteristics on reclaimed, disturbed lands can cause a shift in the relative influence of SQ factors vs. water redistribution on hillslope production patterns

Merrill, S.D., Liebig, M.A., Hendrickson, J.R., Wick, A. 2018. Soil quality and water redistribution influences on plant production over low hillslopes on reclaimed mined land. International Journal of Agronomy. Vol. 2018, Article ID 1431054, 12 pages. doi.org/10.1155/2018/1431054

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New NGPRL Drone and Interseeder will be highlighted at the July 19 Friends & Neighbors Day

2018 National Resources Inventory (NRI) Rangeland Resource Assessment

Dr. David Toledo

The 2018 National Resources Inventory (NRI) Rangeland Resource Assessment was recently released. This is the third NRI rangeland resource assessment; earlier reports were released in 2010 and 2014.

Dr. David Toledo, NGPRL Range Scientist, participated in the interagency group (ARS, NRCS, Department of Interior, Bureau of Land Management, U.S. Geological Survey, and the Forest Service) that worked together to develop field data collection protocols and data elements that could be used for national inventories.

The NRI survey program is scientifically based, employing recognized statistical sampling methods. The findings focus on key issues in rangeland science, including rangeland health, non-native plant species, non-native and native invasive plant species, bare ground, inter-canopy gaps and soil surface aggregate stability. NRI rangeland data collected in 2004-2010 and 2011-2015 are used to provide estimates of change in rangeland conditions.

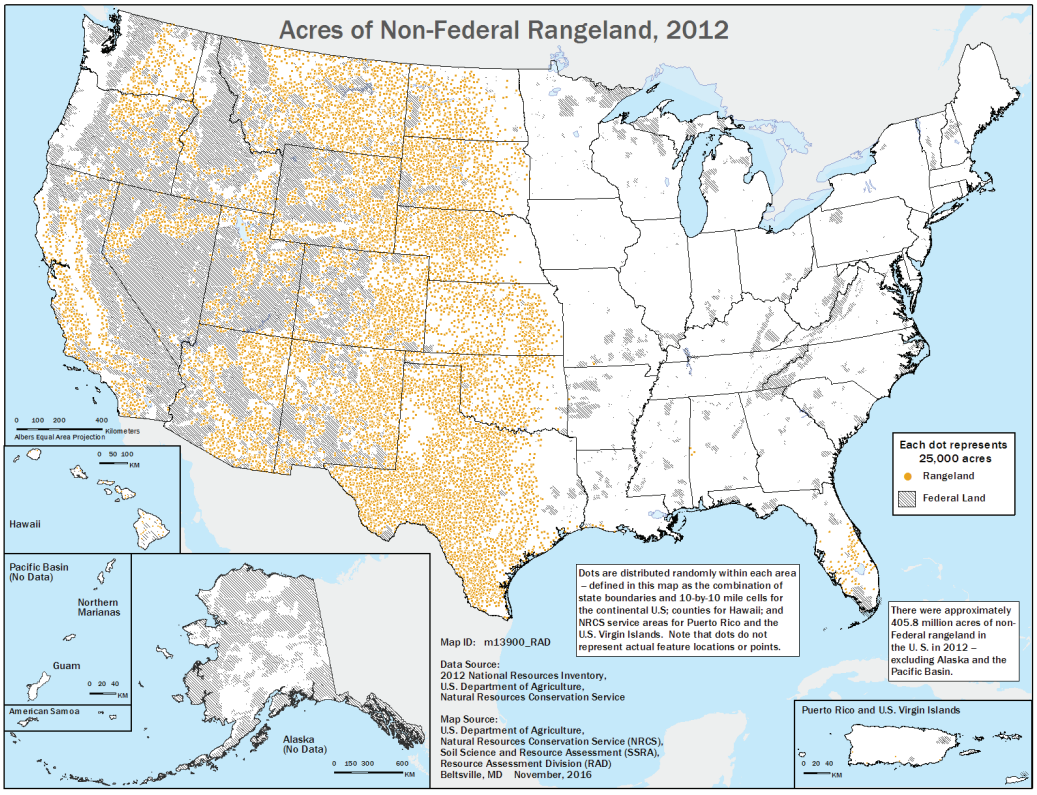
NRI is a statistical survey of land use and natural resource conditions and trends on U.S. lands. Data is continually collected from preselected spots representing hundreds of thousands of acres across the country including rangeland, cropland, and many Bureau of Land Management landscapes. With the assistance of a global positioning system (GPS), data collectors navigate to sample locations and collect on-site data.

Although NRI reports vary depending upon the land being studied, rangeland reports are focused primarily on key issues like rangeland health, non-native plant species, non-native and native invasive plant species, bare ground, inter-canopy gaps and soil surface aggregate stability.

Rangeland is defined by the NRI as a land cover/use category on which the climax or potential plant cover is composed principally of native grasses, grasslike plants, forbs, or shrubs suitable for grazing and browsing, and introduced forage species that are managed like rangeland.

This includes areas where introduced hardy and persistent grasses, such as crested wheatgrass, are planted and such practices as deferred grazing, burning, chaining, and rotational grazing are used, with little or no chemicals or fertilizer being applied.

Rangeland data collected according to these protocols provide information that can be used to assess current conditions, and in the future as sites are revisited, data collected with these protocols will provide the basis for determining changes in rangeland conditions.



Acres of Non-Federal Rangeland, 2012. NRI rangeland on-site data has been collected in 17 western states from North Dakota to Texas and west. Rangeland NRI estimates of nearly 406 million acres of rangeland.

Lessard, V., Spaeth, K., Fults, G., Talbot, C., Metz, L., Pyke, D., Herrick, J.E., Toledo, D.N., Goslee, S.C., Krueger, T., Musser, K. 2018. 2018 National Resources Inventory (NRI) Rangeland Resource Assessment. Government Publication/Report. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/nri/

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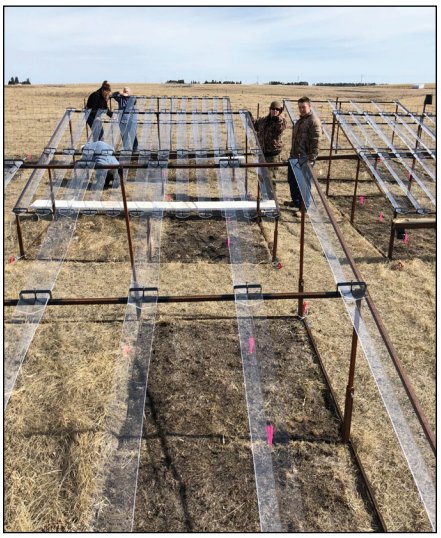
Effect of Cool-season Invasive Grasses on Pollinators and Wildlife Species

Dr. David Toledo

Kentucky bluegrass (Poa pratensis) and/or smooth bromegrass (Bromus inermis) invasion in the northern mixed grass prairie has been rapid and wide spread.



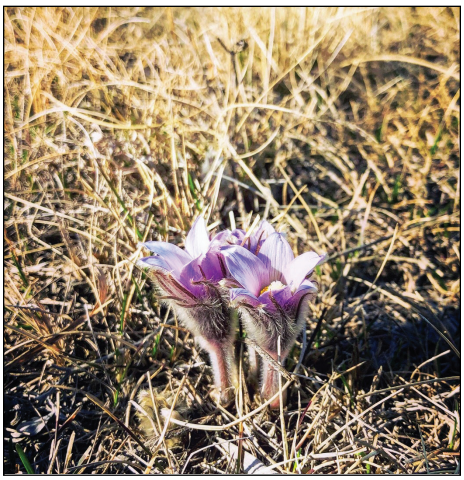
Plant foliar cover and plant biodiversity data from the USDA-ARS Northern Great Plains Research Laboratory, near Mandan suggest that Kentucky bluegrass now covers between 3 and 54% of the pastures sampled and as cover of Kentucky bluegrass increases plant species richness decreases. These data also show how, despite decreases in native species richness and overall biodiversity at a plot scale, at the landscape scale we still see the presence of 140 different native species. Suggesting that management that maintains higher levels of diversity is still within the realm of possibilities.

Data collected by Bob Patton at the NDSU Central Grasslands Research Extension Center between 1988 and 2014 also show an increase of Kentucky bluegrass and smooth bromegrass. These data also show the effect of grazing intensity of these two grasses and the effects of grazing on plant species richness. These data suggest that moderate to heavy grazing of pastures invaded by K. bluegrass and smooth brome can provide an advantage for maintaining species diversity. However, depending on how heavy the grazing, the overall production of heavily grazed pastures might be negatively affected. This stresses the importance of having clearly defined management objectives that weigh the pros and cons of potential management actions.

Despite accelerated expansion, the consequences of Kentucky bluegrass and/or smooth bromegrass on other ecosystem processes remain largely unknown. A review of current available literature suggests that K. bluegrass invasion may have negative effects to ecosystem services, including declines in native pollinators and loss of habitat for wildlife species.

Although most pollinators do not use Kentucky bluegrass directly, the association between Kentucky bluegrass and loss of native plant diversity suggests Kentucky bluegrass may be indirectly affecting pollinators. Diverse vegetation supports a variety of pollinators, providing pollination services necessary for many plants to reproduce and/or produce a crop. Research suggests that plant invasions and loss of native habitat can have a negative effect on pollinator diversity. However, specifics about pollinator types lost because of Kentucky bluegrass and the impacts of these losses is still not well understood.

In terms of wildlife habitat, one of the most important factor associated with population changes of grassland obligate species is loss of native habitat. Loss in vegetative composition and structure favors generalist species that can tolerate a more homogeneous habitat. While bluegrass and bromegrass can be of some value, little information exists on the effects of these grasses on vegetation composition and structure for wildlife.



Current research being performed at the NDSU CGREC, aims to address some of our knowledge deficiencies regarding impacts of invasion of bluegrass and smooth brome on pollinators and wildlife species. Additionally, this new research also aims to address ways to manage this invasion using natural disturbances such as fire and grazing combined with novel management approaches such as patch burn grazing. At the USDA-ARS NGPRL, there is also ongoing research aimed at determining the effects of burning and drought on plant composition and forage value of bluegrass invaded areas.

In terms of expanding our possibilities to adapt to change and apply precautionary measures while this new research bears results, maintaining a broad suit of native forage species that are adapted to site specific conditions will likely yield the greatest long term benefits in terms of livestock production and the sustainability of the rangelands ecosystems.

**An earlier version of this article appeared in the Spring 2018 newsletter of the NDSU Central Grasslands Research and Extension Center.*

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Presentations of NGPRL Science

Since the last issue:

On February 27, 2018, the scientists of the USDA-ARS Northern Great Plains Research Laboratory (NGPRL) in Mandan, ND joined with North Dakota NRCS, Bismarck State College (BSC), and North Dakota State University (NDSU) to host their fourth annual "Farming & Ranching for the Bottom Line" held at the BSC National Energy Center of Excellence. The program which helped family farmers and ranchers manage through the current extreme drought, was under development for over six months. Dr. Mark Liebig, Research Soil Scientist presented, "*Crop Production in a Dry Year*". Dr. Dave Archer, NGPRL Research Leader, presented, "*Economics of Improving Soil Quality*". NDSU specialists focused on the forecasted weather, grazing options in dry conditions, crop and livestock marketing, etc. A panel of Ag bankers focused on financial issues, and nationally recognized Ag broadcaster Al Gustin keynoted the event with a historical perspective of the ups and downs of production agriculture. Joining the audience were 50+ Agriculture students from BSC. Dr. Archer, Dr. John Hendrickson, and Technical Information Specialist Cal Thorson led the development of this program for ARS. Organizing this conference has further strengthened the working relationship of these organizations to collaboratively support production agriculture in North Dakota.

On March 14, 2018, ARS Research Biologist Derek Faust, of the Northern Great Plains Research Laboratory in Mandan ND, presented '*Tasting Thresholds: Introduction to Toxicology*' to 126 fifth grade students at Gateway to Science's Environmental Festival in Bismarck, ND.

On March 15, 2018, ARS staff of the Northern Great Plains Research Laboratory in Mandan, ND, provided a hands-on display allowing over 2000 children and their families to see and touch seeds of crops used to make pizza at the Morton County Agriculture Day in Mandan, ND.

Dr. David Toledo, USDA-ARS Research Rangeland Management Specialist at the Northern Great Plains Research Laboratory in Mandan, ND, taught three Bureau of Land Management courses for the BLM National Training Center. The courses were in in Reno, NV (May 1-4), Grand Junction CO, (May 22-25), and Cheyenne WY (June 19-22). During these training courses students were testing a new version of the "*Interpreting Indicators of Rangeland Health Technical Reference*" which Toledo co-authored. Interpreting Indicators of Rangeland Health is part of the USDA National Resources Inventory, the BLM's Assessment, Inventory, and Monitoring Project, and many other national and international efforts.

On April 19, 2018, ARS Research Biologist Derek Faust and Technical Information Specialist Cal Thorson, of the Northern Great Plains Research Laboratory in Mandan, ND, delivered a Living Seed Necklace activity demonstrating seed germination for students and their families at the Earth Day Festival in Bismarck, ND.

ARS Research Biologist, Derek Faust, of the Northern Great Plains Research Laboratory in Mandan, ND and ARS Research Ecologist, Matthew Moore, of the Water Quality and Ecology Research Unit in Oxford, MS, along with co-authors Robert Kröger and Scott Rush, had a paper, "*Management practices used in agricultural drainage ditches to reduce Gulf of Mexico Hypoxia*", selected as an Earth Day 2018 Highlight by the publisher Springer Nature.

On June 7, Dr. David Toledo, Research Range Management Specialist, at the USDA-ARS Northern Great Plains Research Laboratory, participated in the free Visiting Scientists Series at the Bismarck ND Veterans Memorial Library. The short "Lightning Talks: 5-minute Talk on Science and Technology" presentation that Toledo shared is titled, "*Prescribed Fires: To Burn or Not to Burn*".

On June 25, Dr. Krishna Pokharel, Research Agricultural Economist at the USDA-ARS Northern Great Plains Research Laboratory, presented *"Measuring and Analyzing Financial Performance: A Machine learning Approach"* at the Western Agricultural Economics Associaltion Annual Meeting in Anchorage, Alaska.

New Science Published

Near-surface soil property responses to forage production in a semiarid region https://dl.sciencesocieties.org/publications/sssaj/abstracts/82/1/223 Mark Liebig, John Hendrickson, Jose Franco, David Archer, Kristine Nichols, and Donald Tanaka

Assessing uncertainties in crop and pasture ensemble model simulations of productivity and N_2O emissions https://scholars.opb.msu.edu/en/publications/assessing-uncertainties-in-crop-and-pasture-ensemble-model-simula Fiona Ehrhardt, Jean François Soussana, Gianni Bellocchi, Peter Grace, Russel McAuliffe, Sylvie Recous, Renáta Sándor, Pete Smith, Val Snow, Massimiliano de Antoni Migliorati, Bruno Basso, Arti Bhatia, Lorenzo Brilli, Jordi Doltra, Christopher D. Dorich, Luca Doro, Nuala Fitton, Sandro J. Giacomini, Brian Grant, Matthew T. Harrison, Stephanie K. Jones, Miko U.F. Kirschbaum, Katja Klumpp, Patricia Laville, Joël Léonard, Mark Liebig, Mark Lieffering, Raphaël Martin, Raia S. Massad, Elizabeth Meier, Lutz Merbold, Andrew D. Moore, Vasileios Myrgiotis, Paul Newton, Elizabeth Pattey, Susanne Rolinski, Joanna Sharp, Ward N. Smith, Lianhai Wu, and Qing Zhang

Controlling Kentucky bluegrass with herbicide and burning is influenced by invasion level http://www.bioone.org/doi/pdf/10.1017/inp.2017.2 Corie Ereth, John Hendrickson, Donald Kirby, E. Shawn DeKeyser, Kevin Sedivec, and Mark West

2018 National Resources Inventory (NRI) Rangeland Resource Assessment https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/nri/results/?cid=nrcseprd1343025 V. Lessard, K. Spaeth, G. Fults, C. Talbot, L. Metz, D. Pyke, J.E. Herrick, Toledo, David Toledo, S.C. Goslee, T. Krueger, and K. Musser

Soil quality and water redistribution influences on plant production over low hillslopes on reclaimed mined land https://www.hindawi.com/journals/ija/2018/1431054/ Stephen Merrill, Mark Liebig, John Hendrickson, and Abbey Wick

Assessment of benefits of conservation agriculture on soil functions in arable production systems in Europe https://www.researchgate.net/publication/323741503_Assessment_of_Benefits_of_Conservation_Agriculture_on_Soil_Functions_in_Arable_Production_Systems_in_Europe Bhim Ghaley, Teodor Rusu, Taru Sanden, Heidi Spiegel, Cristina Menta, Giovanna Visioli, Isabelle Gattin, Antonio Delgado, Mark Liebig, Dirk Vrebos, Tamas Szegi, Erika Micheli, Horia Cacovean, and Christian Henriksen

Intercropped watermelon for weed suppression in a low-input organic system http://horttech.ashspublications.org/content/28/2/172.abstract Jose Franco, Stephen King, Joseph Masabni and Astrid Volder

Examining farmers' willingness to grow and allocate land for oilseed crops for biofuel production https://www.sciencedirect.com/science/article/pii/S0140988318300847 W.T. Embaye, J.S. Bergtold, David Archer, C. Flora, G.C., Andrango, M. Odening, and J. Buysse

Carbon use and uptake efficiencies of hayed alfalfa and grassland in a semiarid environment https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecs2.2147 Nicanor Saliendra, Mark Liebig, and Scott Kronberg

Manure and residue inputs maintained SOC in conservation production systems in the Upper Midwest S.L. Weyers, Jane Johnson, Dave Archer, Ron Gesch, and Frank Forcella. Soil Sci. Soc. Am. J. doi:10.2136/sssaj2017.09.0344. 2018.

Can reducing tillage and increasing crop diversity benefit grain and forage production? S.L. Weyers, David Archer, F. Forcella, Ron Gesch, Jane Johnson. 2017. Renewable Agriculture and Food Systems. doi: 10.1017/S1742170517000187.

Strip-tillage reduces productivity in organically managed grain and forage cropping systems in the Upper Midwest, S.L. Weyers, David Archer, Frank Forcella, R.on Gesch, Jane Johnson. 2017. Renewable Agriculture and Food Systems. doi: 10.1017/S1742170517000084.

Spring Wheat Yields Following Perennial Forages in a Semiarid No-Till Cropping System. Jose Franco, S.E. Duke, John Hendrickson, Mark Liebig, Kris Nichols, and Don Tanaka. Agronomy Journal. doi: 10.2134/agronj2018.01.0072. 2018.

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New Science Published

Sunflower floral dimension measurements using digital image processing. S. Sunoj, , S.N. Subhashree, S. Dharani, C. Igathinathane, Jose Franco, R.E. Mallinger, J.R. Prasifka, David Archer. Computers and Electronics in Agriculture, 151, 403-415; doi:10.1016/j.compag. 2018

Intercropping Halophytes to Mitigate Salinity Stress in Watermelon. Jose Franco, C. Simpson, S.R. King, and A. Volder. Sustainability. 10(3), 681; doi:10.3390/su1003068. 2018

Component Crop Physiology and Water Use Efficiency in Response to Intercropping. Jose Franco, J.G., S. King, and A. Volder. European Journal of Agronomy. 93, 27-39. doi.org/10.1016/j.eja.2017.11.005. 2018.

Evaluating strategies for sustainable intensification of U.S. agriculture through the Long-Term Agroecosystem Research network. S.A. Spiegal, B.T. Bestelmeyer, , David Archer, D.J. Augustine, E. Boughton, R. Boughton, P. Clark, P., Justin Derner, E.W. Duncan, M.A. Cavigelli, C.J. Hapeman, R.D. Harmel, P. Heilman, M.A. Holly, R. Huggins, K.W. King, P.J. Kleinman, Mark Liebig, M.A. Locke, G.W. Mccarty, N. Millar, S.B. Mirsky, T.B. Moorman, F.B. Pierson Jr, J.R. Rigby Jr, G. Robertson, J.L. Steiner, T.C. Strickland, H. Swain, B.J. Wienhold, J. Wulfhorts, M. Yost, C.L. Walthall, Environmental Research Letters. 13(3):034031. https://doi.org/10.1088/1748-9326/aaa779. 2018

Long term soil pH change in rainfed cropping systems: is acidification systemic? Mark Liebig, J.L. Reeves, S.L. Osborne, W.E. Riedell, Marty Schmer, V.L. Jin, U.M. Sainju. Proceedings of Great Plains Soil Fertility Conference. Vol. 17/pp. 210-214. 2018

Krishna Pokharel completes his assignment

Dr. Krishna Pokharel, Research Agricultural Economist, left the NGPRL at the end of June to take a permanent position with the Federal Energy Regulatory Commission in Washington, DC. Krishna was a postdoc working with Dr. Archer on crop modeling and economic analysis as part of the oilseed to jet fuel and climate resilience grant-funded projects. We wish him all the best in his new position.