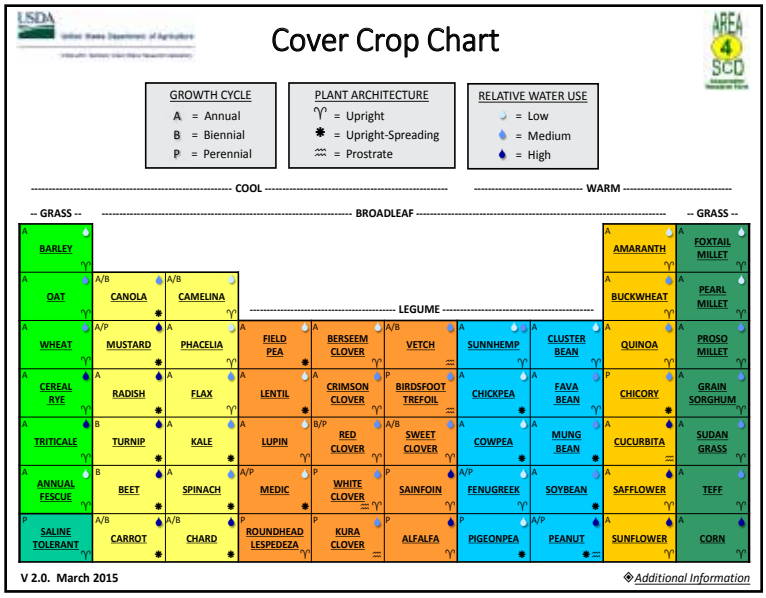
Chart makes it easier to select cover crops

Sandra Avant, Agricultural Research Service

An online tool called the "Cover Crop Chart" is helping U.S. farmers decide which cover crops to plant and is generating interest from growers in other countries.

Cover crops can help reduce soil erosion, increase organic matter, improve early weed control, and provide forage for animals. They can also benefit the public by improving water quality, air quality, and wildlife habitat.

Drought conditions in recent years have renewed many growers' and ranchers' interest in cover crops—which are typically grown during the off-season—to help mitigate effects of extreme weather conditions. This interest has increased the need for information on suitable crops to help growers meet their individual production and management goals.



To help address these needs, researchers at the Agricultural Research Service's Northern Great Plains Research Laboratory (NGPRL) in Mandan, North Dakota, developed the Cover Crop Chart. It is available on the NGPRL home page (http://www.ars.usda.gov/pa/ngprl) and can be downloaded for free.

"Although a lot of information is available on cover crops, it is often organized by individual crops. Unfortunately, this way of looking at cover crops falls short in showing how they could potentially complement each other in mixtures," says NGPRL soil scientist Mark Liebig.

Patterned after the periodic table of elements, the interactive chart includes information on crop species that may be planted individually or in mixtures and gives specifics on growth cycle, relative water use, plant architecture, forage quality, pollination, and more.

"In developing the chart, we realized that just as chemical elements are grouped by the same electron configurations, crops could be categorized by similar attributes—cool season or warm season, grasses or broadleaf, and legumes," Liebig says.

The chart allows growers to see the broad spectrum of potential options that may work best for them, he adds. It also includes relevant research at NGPRL, particularly on forage quality, water use, and sequencing of individual crops.

"We're basically repackaging information into a useful visual aid—a first step for customers to learn about cover crops," Liebig says.

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In addition to U.S. customers, growers from 37 other countries have already used the chart since its initial release in 2010. Feedback from users highlighted the educational value of the chart and provided suggestions that are included in a 2015 update. The chart now includes 12 more crops for a total of 58 species, provides information on saline-tolerant grasses, and addresses the placement of crop species within a cash-crop rotation.

"Customers also suggested a downloadable application for mobile devices," Liebig says. "We hope to be able to provide this type of access to the chart in the future."

By Sandra Avant, Agricultural Research Service Information Staff. "Chart Makes It Easier To Select Cover Crops" was published in the June 2015 issue of AgResearch Magazine.
http://agresearchmag.ars.usda.gov/2015/jun/crops/

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Siberian larch provenance test at NGPRL

Legacies

Matt Sanderson, NGPRL Research Leader

As a century old research facility, the NGPRL has a number of legacies. For example, we have a 100-year record of cattle production from native rangeland and an archive of 5000 soil samples from studies conducted across the Great Plains since the 1930s.

A unique living legacy, however, is the collection of various blocks of trees originally used for tree improvement and shelterbelt research. These include provenance test blocks of ponderosa pine, lodgepole pine, bur oak, hackberry, Siberian larch, eastern red cedar, and juniper along with seed orchards of bur oak, Siberian larch, and Siberian elm.

Although tree research at NGPRL ended several years ago, we maintain these legacy tree blocks for use by others. For example, in 2009 representatives from the North Dakota Forest Service, North Dakota State University and USDA-NRCS Plant Materials Center began converting the Siberian larch provenance test to a seed orchard. In the same year, similar efforts were applied to the bur oak provenance test.

In both situations, cull trees were thinned and the stand made more resilient in an effort to preserve the diverse genetics for the future.

In 2014, Craig Stange, forester with the USDA-NRCS Plant Materials Center in Bismarck, worked with several partners from the North Dakota Forest Service, NDSU Extension, Burleigh County Soil Conservation District, USDA-ARS and USDA-NRCS to rejuvenate a lodge pole pine block, converting it to a seed orchard, making it more stress and wildfire resistant. Lodgepole cones were collected to generate new seedlings for further testing in three states.

Craig's expertise, dedication, hard work, and partnership not only enabled us at NGPRL to maintain this important living legacy, but also to use it to benefit the citizens of the Northern Great Plains.

This living legacy of trees will be featured at our annual Friends and Neighbors Day on July 16. Craig Stange will conduct a tour of several tree plantings and explain how they are being used.

We hope you will join us on July 16 to learn not only about this unique living legacy, but also about all of our research on crops, livestock, soil health, and grazinglands.

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Improving cattle nutrition on the Great Plains with shrubs and fecal seeding of fourwing saltbush

Scott Kronberg, USDA-ARS

Increasing the diversity of grassland vegetation with cold-tolerant, palatable, and often native shrubs can improve forage quality for livestock (and wild ruminants) by providing protein, calcium, phosphorus, and other nutrients in late summer, fall, and winter.

Research was conducted to estimate the percentage of fourwing saltbush or winterfat (palatable shrubs) needed in the diet of cattle to improve overall dietary digestibility when they graze mature, low-quality cool-season grass in late summer, fall and winter.

Mixtures of fourwing saltbush and mature smooth bromegrass or winterfat and bromegrass had greater digestibility than smooth bromegrass alone. Similar relationships were observed with mixtures of fourwing saltbush and mature Altai wildrye.

Additional research was conducted to estimate the percentage of fourwing saltbush and winterfat seeds that could survive passage through the bovine gastro-intestinal tract such that seeds have potential for fecal seeding (establishing new plants from cattle dung).

Fourwing saltbush (Atriplex canescens) is a plant adapted to dry places from North Dakota to Mexico. It is found from short-grass prairie, dry shrublands, to deserts.

Germination of Dakota-grown fourwing saltbush seeds that were incubated for 24 or 48 hours in a simulated cattle GI tract, was 55 and 47%, respectively, with no difference in germination for the one-day and two-day incubations, but more seeds germinated if incubated versus not incubated.

Germination of Utah-grown fourwing saltbush seeds, which were incubated for 24 or 48 hours with high, medium or low quality forage, averaged only 9 and 8%, respectively.

Length of incubation, forage quality and their interaction did not influence germination. Germination of Utah-grown fourwing saltbush seeds that were not incubated was 21% and much greater than for incubated seeds.

Average germination of winterfat seeds was only 0.6 and 0.1% for the 24 and 48 hour incubations, respectively, with incubation length, forage quality and their interaction not having significant influence on germination. Therefore, it will be more practical to broadcast winterfat seed than to try to seed it with cattle fecal seeding.

Non-incubated winterfat seeds had much greater germination than incubated seeds. Results from a final trial were confirmatory for Dakota-grown fourwing seeds.

Fourwing saltbush and winterfat can improve diet quality of grazing cattle in later summer through winter, and some fourwing saltbush seeds have potential for fecal seeding.

Winterfat is highly palatable and sought out by livestock.

Citation: Kronberg, S.L. 2015. Improving cattle nutrition on the Great Plains with shrubs and fecal seeding of fourwing saltbush. Rangeland Ecology and Management. 68:285-289.
http://www.sciencedirect.com/science/article/pii/S155074241500055X

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Rangeland health assessment - The key to understanding and assessing rangeland soil health in the Northern Great Plains

David Toledo, USDA-ARS, and Jeff Printz, NRCS

As the science related to soil and rangeland health evolves, so do their protocols and assessment methodologies.

Rangeland health assessments consist of evaluating how well ecological processes such as the water cycle, energy flow and nutrient cycling are functioning at a site. When soil health deteriorates, its capacity to support and regulate ecosystems is diminished affecting energy flows, nutrient cycling, and productivity among others.

Soil health is the capacity of a soil to maintain its function and flow of ecosystem services given a specific set of physical, chemical and environmental boundaries.

Jeff Printz, NRCS Range Specialist, teaching a class in Rangeland Health Assessment at NGPRL in 2014

The USDA has placed and increased emphasis on soil health and has developed a set of key principles to soil health: 1. Use plant diversity to increase diversity in the soil. 2. Manage soils more by disturbing them less. 3. Keep plants growing throughout the year to feed the soil. 4. Keep the soil covered as much as possible.

Soil health principles have been developed primarily for agricultural systems yet they are relevant to all soils and therefore also apply to rangelands. However, there are concerns regarding the application of these four soil health principles to rangeland ecology and management.

This paper clarifies how each of these principles applies to rangeland ecology and describe how existing science-based inventory protocols can be used to assess not only the health of the rangeland soil resource but also the overall health of the rangeland resource.

Our approach consists in explaining how each of the four soil principles listed above is relevant to rangeland health and we list the indicators of rangeland health that each soil health principle is related to.

Citation: Printz, J., Toledo, D.N., Boltz, S. 2014. Rangeland health assessment - The key to understanding and assessing rangeland soil health in the Northern Great Plains. Journal of Soil and Water Conservation. 69(3):73A-77A. http://www.jswconline.org/content/69/3/73A.full.pdf+html

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David Toledo, NGPRL research rangeland management specialist post doc; Jeff Printz and Stan Boltz, NRCS, have been selected for the "Editor's Choice Award - Honorable Mention" award from the Soil Water Conservation Society (SWCS). The award recognizes the excellence of their research paper, "The key to understanding and assessing rangeland soil health in the Northern Great Plains" (above), in the Journal of Soil and Water Conservation. The award will be presented in July at the International Annual Conference of the Soil and Water Conservation Society in Greensboro, NC.

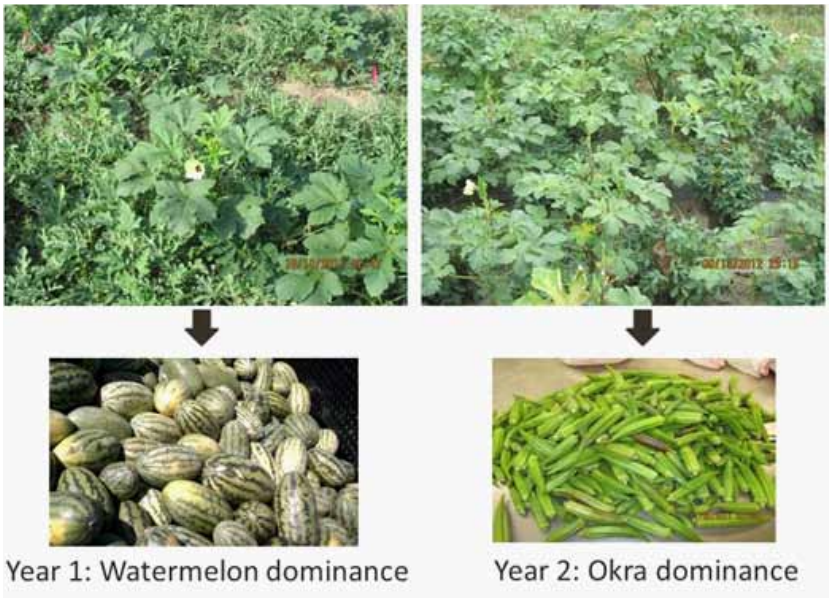
Feel free to pass on this issue of Northern Great Plains Integrator to others interested in agricultural research in the northern Great Plains. Northern Great Plains Integrator is published and distributed by the USDA-ARS, Northern Great Plains Research Laboratory, PO Box 459, Mandan, ND 58554. Use of 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

Multifunctional mixtures: Brief results from a vegetable intercropping study and how this can help with cover crop mixture selection in integrated cropping systems of the Northern Great Plains

Jose Franco, USDA-ARS

In natural ecosystems, functionally diverse plant communities produce more plant biomass than monocultures.

Through a complex set of interactions between different species, plant communities that have a diverse set of plant functional types are able to use available resources more efficiently and completely as a whole.



Additionally, diverse plant communities are typically characterized by a collection of species that are complementary in growth forms.

These concepts were the basis for the research conducted on mixed cropping of vegetable crops, whereby each of the 5 crops selected for the study would have a specific function within the system. The 5 crops are all commonly grown crops in the southern region of the United States where this study was conducted: peanut, watermelon, okra, cowpea, and pepper.

Although it is generally accepted in the scientific community that functionally diverse ecosystems produce more overall biomass, there is less certainty in how this would translate to harvestable yields in mixed cropping systems.

From this research, we found that intercropping systems consisting of 3 to 4 functionally diverse species resulted in an overall increase in fruit production both years of the two-year experiment.

Due to changes in planting dates of component crops, there were changes in dominance resulting in watermelon dominating the community in year 1 and okra dominating in year 2.

Despite these changes in dominance, diverse plant communities consistently produced more harvestable and marketable material per unit land area.

Due to competition with okra in year 2, we found evidence to suggest watermelon altered its growth and allocation patterns.

With both crops present and particularly in the 3 and 4 species systems where okra density was highest, watermelon leaves were larger and thinner so as to maximize capture of light.

This suggests watermelon underwent changes at the leaf level to acclimate to its light environment. By undergoing these changes, watermelon was able to capture more light and maintain photosynthetic capacity per unit leaf area relatively constant, which we also found in this study.

How can this information help producers in the Northern Great Plains with cover crop mixture selection? With so many cover crop species currently available to producers, the number of possible combinations in cover crop mixtures is virtually limitless.

The idea of multifunctional cover crop mixtures is not a new one. These mixtures commonly account for factors such as complementarity of growth periods of component species (sowing and termination dates), cold hardiness, weed-suppressive abilities, N-fixation and -scavenging abilities, complementarity of growth forms, and other factors.

However, an additional factor that should be accounted for when selecting cover crop mixtures and requires further investigation is the effect these mixtures have on plant growth and C to N allocation patterns due to species interactions.

Mixtures should be selected to maximize productivity per unit land area, and just as importantly, to optimize plant tissue C to N depending upon the goals of the producer; whether it be optimizing forage quality, extending soil organic matter residence time, or providing short-term influxes of nutrients.

Franco, J.G., S.R. King, J.G. Masabni, and A. Volder. 2015. Plant functional diversity improves short-term yields in a low-input intercropping system. Agriculture, Ecosystems and Environment 203:1-10.
http://www.sciencedirect.com/science/article/pii/S0167880915000195

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Seedling performance associated with live or herbicide treated tall fescue

Jonathan Halvorson, USDA-ARS

Tall fescue is an important forage grass that typically grows in association with a fungus thought to be advantageous to the plants but which may negatively impact livestock, affect soil conditions, and inhibit the establishment of legumes.

We compared seedling performance of three legumes and three cultivars of tall fescue with different fungal associations, grown in soil from living and killed fescue sods.

Contrary to our expectations legume seedling root growth proved less successful in killed than live fescue soil especially for small-seeded white clover.

We also found seasonal patterns of seedling growth with evidence for inhibition of seedlings in killed soil most strongly expressed in soil collected after the growing season compared to spring.

These patterns suggest establishing legumes or fescue cultivars is not improved by first killing the existing fescue sod, seedling performance can exhibit significant inter-seasonal variation, related only to soil conditions.

If the results from the microcosm work can be verified under field conditions, avoiding the use of herbicides complies with and facilitates organic agricultural practice and reduces expenses and environmental concerns in conventional production systems.

Citation: Halvorson, J.J., Belesky, D.P., Godwin, H.W. 2015. Seedling performance associated with live or herbicide treated tall fescue. International Journal of Agronomy. Vol. 2015, Article ID 841213, 11 pages, doi:10.1155/2015/841213.
http://www.hindawi.com/journals/ija/2015/841213/abs/

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New faces

Justin Feld has rejoined the NGPRL as a biological technician under Dr. Mark Liebig. Justin comes to the NGPRL from the North Dakota Department of Health: Environmental Health Section. He received his degree from Paul Smith's College in Saranac Lake, NY and is originally from Green Bay, WI.

Joseph Stegmiller has joined the cattle research program at NGPRL. Joseph is a native of Flasher, ND and graduated from NDSU with a Bachelors in Zoology and a Masters in Entomology. He was previously employed at the Morton County Soil Conservation District.

Jeremy Bauer has joined the administrative staff as the new purchasing agent. He is a longtime Mandan resident. Jeremy has an extensive background in purchasing, sales, and inventory control. He previously was with Balancing Professionals.

Dr. Jose G. Franco, Jr. joined the staff at the Northern Great Plains Research Laboratory in June. Franco is a post-doctoral research associate responsible for improving our understanding of the ecological interactions between crops in integrated cropping systems. His work will focus on species interactions in both conventional and organic mixed cropping systems and how they affect short- and long-term yields, and their ability to enhance ecosystem services and build resiliency into production systems. Franco's previous research includes working on multi-species organic intercropping of vegetables to reduce plant heat stress and maximize total food production and on integrated cropping approaches to reduce salt stress on watermelon and introduce value-added crops in Texas.