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INCORPORATING COVER CROPS

NDSU | EXTENSION

SOIL HEALTH

COVERING UP *North Dakota*

One soil health building approach gaining interest with farmers is the inclusion of cover crops in rotation. In a short growing season like we have in North Dakota, effectively using cover crops can seem like a challenge. However, farmers are interested in including cover crops to meet specific on-farm goals such as minimizing soil erosion, moisture management, weed suppression and improving soil conditions that they are unable to achieve by only having their cash crops in rotation. Establishing a specific on-farm goal is key to utilizing cover crops successfully.

To **minimize erosion**, farmers generally are looking to increase ground cover following low residue crops such as soybean or edible beans. In this case, having a cover crop that can be seeded after harvest or flown on just before leaf drop is beneficial. If seeded after harvest, a winter annual such as, cereal rye, winter wheat, or winter triticale would be a good fit because of cold tolerance and an ability to over winter and produce biomass in the spring. Winter camelina is a broadleaf that also will over winter, but it needs to be mixed with a grass to get coverage and reduce erosion. If broadcasting or flying on cover crops prior to leaf drop, small seeded species along with a cool-season grass are desirable. Timing is everything to avoid issues of a growing cover crop underneath a bean crop prior harvest.

Moisture management is a good fit for using cover crops in both reducing and maintaining moisture. Transpiration by plants to remove water, movement of water down intact root channels into the soil for storage and crop residue to reduce evaporation and maintain surface moisture, and are all ways cover crops can help manage water in a system. Depending on crop rotation, soil properties and goals, cover crop mixes including deep- and shallow-rooted species, fibrous tap roots, varying levels of water use, biomass production and residue breakdown can be selected.

Suppressing weeds by using cover crops as an additional mode of action to a herbicide program is becoming more popular. Cereal rye is the primary cover crop choice for weed suppression used because of its competitive and a strong allelopathic effect. Other cover crops can be competitive as well, depending on the situation. To manage weeds in a salt-affected areas, using barley (which is more salt-tolerant than cereal rye) or a mix of barley and cereal rye are great options. The whole goal is to use cover crops that work with a herbicide program.

Improving soil conditions using cover crops is centered on having a living root growing in the soil for as long as possible. A living root provides benefits of supporting biological activity in areas immediately surrounding the roots (a zone called the rhizosphere), wrapping around and gluing soil particles together to form aggregates, capturing nutrients that are readily leached from soils such as nitrates, and creating intact root channels from the surface into

TOPICS *covered*

the soil for water and air movement. To maximize on a having a living root in the soil, approaches like interseeding can be used.

Using cover crops in the northern Great Plains region has additiona,l benefits. What is important is that those benefits and goals are different for every farm, really every field. Getting familiar with and then fine-tuning approaches is important to achieve desired outcomes. In this publication, we provide a starting point based on what we know at North Dakota State University.

Section written by: Abbey Wick, NDSU

CALEY GASCH

Assistant Professor of
Soil Health-Research

By leading the soil health research program at North Dakota State University, I have a unique opportunity and responsibility to provide science-based, research-driven information on management practices that build soil health. I not only look for the gaps in existing information to guide my research, but also build relationships with farmers to learn about their needs as they integrate new practices on-farm. I ask myself at the end of each workday, "What did I do to help farmers today?" Asking this question helps me stay in touch with needs related to soil health and keeps the research being conducted at North Dakota State University relevant.

@ckgasch

RESEARCH *& Extension* NDSU

ABBEY WICK

Assistant Professor of
Soil Health-Extension

Getting information developed by researchers into the hands of farmers, consultants and industry is incredibly important for the adoption of new practices on-farm. On the flip side, sharing information and questions from those same groups with researchers on campus is also important for generating meaningful research. I focus on personal relationships, partnerships and using high- and low-tech approaches to share information. This may be in the form of Twitter to reach a broad audience or one-on-one visits with farmers to evaluate a system.

ndsu.edu/soilhealth

@NDSUsoilhealth

COVER CROPS BY *Function*

Cover crops can be classified by botanical family (grasses, legumes, brassicas, others), by growth cycle (cool- and warm-season) and by function.

The main functions are:

Soil builders: Crops with a fibrous root system (grasses) add carbon to the soil increasing organic matter and provide food for soil microorganisms. These crops form a symbiotic association with mycorrhizae which form a web in the soil, channeling nutrients to the plant. Also, microorganisms exude glue-like substances that keep soil particles together, forming stable aggregates.

Nitrogen fixers: Legumes fix atmospheric nitrogen (N_2) by symbiotic association with soil bacteria. Once a legume plant dies, nitrogen-rich root nodules release the nitrogen to the soil, feeding microbes, which in time, will release nitrogen to the following crop.

Nutrient scavengers: Plants in the Brassica family (radish, turnip, rape) have a tap root that can grow 4 to 6 feet deep and capture nutrients lost from the crop's rooting zone, preventing nitrate leaching.

Soil looseners: Brassicas thick and strong tap root reduces soil compaction and increases water infiltration by providing macropores and channels for the water and crop roots to move through.

Soil erosion preventers: Soil particles lost by wind in dry winters and springs are rich in phosphorus. Further, soluble-nitrate can run-off easily during large rain events throughout the season. Most cereal cover crops provide good cover in the fall and their residue protects soil in the winter. Cereal rye is the only cover crop that consistently survives the winters in North Dakota and it is the best cover crop to provide soil cover in the spring.

Cover crops can provide other functions such as suppress weeds, conserve soil moisture, improve water quality, recover salt-affected soils, enhance wildlife habitat, provide food sources for pollinators and forage for grazing. Selecting cover crops based on function is a good way to achieve on-farm goals.

Section written by: Marisol Berti, NDSU

5 TIPS FOR *using cover crops*

1. Get more information by attending Extension events and using other resources that are science-based.
2. Connect with farmers interested in or already using cover crops.
3. Determine on-farm goals and how cover crops can help accomplish those goals.
4. Select species based on function, crop rotation and comfort level.
5. Evaluate cover crops used on your farm and continue to modify approaches.

RESEARCHER *Profile*

MARISOL BERTI

Professor of Forage and Biomass Crop Production

I conduct research on forage and cover crops at North Dakota State University, working with cover crop production for grazing, and interseeding cover crops in corn and soybean, along with including perennial phases in crop rotations. Selecting cover crops based on function has led to recommendations specifically for grazing based on above-ground biomass production and protein content and also for building soil health, with the focus being on root structures and residue. Finding appropriate cover crops for use in the northern Plains climate has led to evaluation of winter camelina as a winter annual for interseeding or relay cropping.

Helping farmers and training other educators on effectively using cover crops is important for seeing the adoption of concepts from research. From large meetings to one-on-one interactions, I provide valuable science-based information that can be adopted to meet on-farm goals.

I also am involved in the Midwest Forage Association (**midwestforage.org**) and the Midwest Cover Crop Council. (**mccc.msu.edu**)

ag.ndsu.edu/plantsciences/research/forages

ADDING DIVERSITY
A Balanced

Soil health is like human health – a balanced diet increases function and efficiency. Because of the biological component of soils, we can relate our inputs to the soil like we do food to our bodies. When we eat healthier and more diverse food, we feel better and function at a higher level than when we are eating poorly. The diversity of high-quality materials being added to soils can have the same effect on soil function.

Developing a diet to support diverse biological communities in the soil can be accomplished by using crop rotation and also inclusion of cover crops. A diverse biological community is important for maximizing processes in the soil that release nutrients for crop use, develop soil structural components to aid in soil water and air movement, and provide interactions that help control diseases and pests. If diversifying the crop rotation is not an option, including cover crops in a current rotation is an important tool for building healthier soils.

Determining which cover crops to include for a given rotation can be guided by the "Five Food Groups" concept developed by Lee Briese, certified crop advisor with Centrol Crop Consulting. The five food groups are cool-season grasses, cool-season broadleaves, warm-season grasses, warm-season broadleaves and legumes. The primary goal is to include each of the five food groups within a couple of years using cash crops and cover crops. For example, in a corn-soybean rotation, the cash crops being grown already fill the warm-season grass, warm-season broadleaf and legume groups. So, we just need to add a cool-season grass and a cool-season broadleaf. This can be accomplished by interseeding cereal rye and radish into a corn crop. By doing this, we can include all five food groups in two years with a simple approach.

As the soil health system advances, additional cover crops may be included to add more diversity to the system. For example, additional cover crops such as flax or dwarf Essex rapeseed may be included in the interseeding mix to add more functions to the system. Cover crops may be interseeded or flown on into soybean before leaf drop to provide more diversity.

Consider the five food groups when selecting cover crops to balance the system, but also consider adding diversity in root structures. Not all roots are created equally in structure, quantity or quality. Having a mix of fibrous roots of grasses along with deep tap roots of brassicas and nitrogen fixing legumes can help build the system. Some roots such as those of a brassica or legume have more nitrogen in them and less carbon, meaning they are also a higher quality food source for soil biological communities.

Considering the quantity of roots and the

Diet

areas of the soil that those roots reach also is important. Fibrous roots can explore parts of the soil the other cover crop roots may not reach. Plus, fibrous roots are excellent for building soil aggregates and creating space for microbial communities to survive and thrive.

When adding diversity to a crop rotation, keep it simple. As you get more comfortable with the concepts, additional diversity can be added to the system.

Section written by: Abbey Wick, NDSU; Lee Briese, Centrol Crop Consulting

5 FOOD GROUPS *to include in rotation*

1. **Cool-season grass**
   (*barley, spring wheat, winter wheat,* cereal rye, oats, triticale)
2. **Cool-season broadleaf**
   (*canola, peas, flax,* dwarf essex rapeseed, faba bean, radish, turnip)
3. **Warm-season grass** (*corn*, millet, sorghum x sudangrass)
4. **Warm-season broadleaf** (*buckwheat, soybean, sunflower*)
5. **Legume** (*peas, soybean,* clovers, faba bean)

**Crops in italics are those grown as cash crops*. Cash crops count towards one the five food groups.

CONSULTANT *Profile*

LEE BRIESE

Edgeley, N.D.

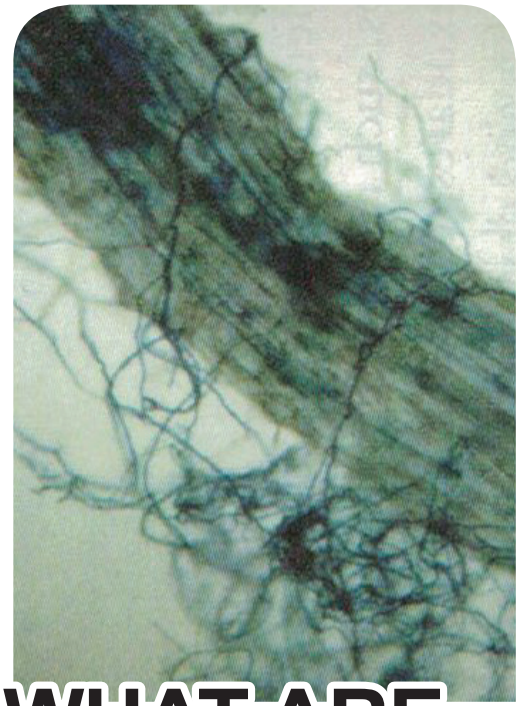
Lee is a certified crop advisor with Centrol Crop Consulting advising on 16 different crops over 80,000 acres. Based out of Edgeley, N.D., he has helped many farmers incorporate cover crops along with other approaches to achieve goals related to soil health.

He encourages simple cover crop mixes that farmers are comfortable managing, using the "Five Food Groups" concept. Simplifying the approach makes it easier to include cover crops in any system.

Integrating cover crops as a mode of action for weed control is also an approach Lee helps his growers adopt. He recommends growers should select their herbicide management program first and then fit cover crops into that program. This has led to providing guidance on effects of herbicide residual on cover crop establishment.

Information from Lee relating cover crops is included in the NDSU Weed Control Guide, which is posted on the NDSU Soil Health webpage (**ndsu.edu/soilhealth**).

@Lee_Briese



WHAT ARE *Mycorrhizae?*

In agricultural and grassland soils, the most common type of mycorrhizal fungi are the arbuscular mycorrhizal fungi, or AMF. About 80% of all plant species form relationships with AMF, which is good because these fungi cannot survive without a root. AMF are a diverse group of fungi and they are widespread in soil.

In this symbiosis, the plant sends carbohydrates to the fungus, which it uses for energy and growth. The extensive network of microscopic hyphae explores a large volume of soil, scavenging nutrients that the plant roots cannot access on their own. The fungus then sends the nutrients (especially phosphorus) to the plant, improving plant nutrition and resistance to stress. In this way, the relationship is mutually beneficial. AMF hyphae also stabilize soil aggregates.

Section written by: Caley Gasch, NDSU

NUTRIENT CAPTURE *Keep it*

Cover crops play an important role in nutrient capture, preventing nitrate loss through leaching and phosphorus loss by run off or soil erosion during the fall and winter months. Once the cover crops are winter-killed, nutrients are released into the soil to feed soil macro- and microorganisms (bacteria, fungi, earthworms, insects and other arthropods).

Cover crops capture nutrients in multiple ways according to their root structure, symbiotic association with microorganisms, and the biomass produced during the growth of the cover crop.

Nutrient capture can be measured by analyzing the nitrogen (N) and phosphorus (P) content in the plant biomass.

N or P content x total dry matter cover crop = total nutrient capture (lbs/ac)

The nutrient capture by a cover crop depends on three main factors:

Soil-available nutrient content, usually comprised of fertilizer, N_2 fixation, or P mobilization by mycorrhizae.

Size matters: The more plant growth or dry matter produced from planting to a hard-killing frost, the higher the nutrient capture. Plant growth depends on available soil moisture. If it doesn't rain, growth and nutrient capture will be limited.

Time matters: The longer the cover crop is allowed to grow before killing a frost, the more biomass will be provided and nutrients captured. Plant as early as possible after cereal crop harvest. In corn or soybean, plan to broadcast or interseed the cover crop before harvest. If planting after Aug. 15, do not plant warm-season cover crops or legumes. They won't grow big enough to capture nutrients to be cost-effective.

Efficient

With a soil test (0 to 24 inches) is greater than 60 pounds of nitrogen per acre (lbs N/ac) before planting the cover crop, a planting date before Aug. 15 and enough rainfall to grow nutrient capture ranges are:

Cool-season legumes *(faba bean, hairy vetch, pea)* = 80-120 lbs of N/ac

Brassicas *(radish, rape, turnip)* = 40-60 lbs N/ac and 8-15 lbs P/ac

Cereals *(barley, oat, rye, triticale)* = 40-60 lbs N/ac and 10 lbs P/ac

Warm-season cereals *(forage sorghum, sudangrass, millet)* = 100 lbs N/ac, if planted before July 30

Availability of the nutrients being captured by cover crops to the following cash crop are currently being evaluated by North Dakota State University.

Section written by: Marisol Berti

OVERWINTERING *Stayin' Alive*

With a short growing season in the northern Great Plains, using winter annual cover crops in rotation is a benefit for getting growth in the fall and then again in the spring prior to planting. With an overwintering cover crop, it is extremely important to (1) consider any additional management steps and monitoring that need to occur and (2) recognize that there are limits for which cash crops can be planted the following year.

For example, a winter annual will use water in the spring and may excessively dry the soil prior to planting. In dry conditions, winter annual cover crops need to be monitored and terminated prior to planting.

For limitations on cash crops in rotation, a winter annual could contaminate grain at harvest in the case of small grains, transfer diseases and pests to the cash crops and tie up necessary nutrients. Cover crop termination must follow USDA NRCS cover crop termination guidelines or a deviation can be requested where warranted by RMA special provisions. It is extremely important to evaluate the entire system prior to using winter annual cover crops.

Of the winter annuals, cereal rye (also called winter rye and grain rye) is the most winter-hearty, giving it a high success rate for survival in our climate. Other benefits are that it is fairly easy to establish, grows quickly and provides excellent weed suppression and the seed is fairly inexpensive. Seeding rates should be selected based on goals and conditions, but here are some starting points:

Interseeded in corn (any time after five-leaf stage), rates from 20 - 40 lb/ac

Flown on into corn (up to tasseling), rates from 40 - 70 lb/ac

Seeded following harvest of an early season crop (early August), rates from 30 - 40 lb/ac

Seeded following harvest of a late-season crop (late September), rates from 40 - 60 lb/ac

Variable rate seeding rye based on soil type, rates from 10 - 60 lb/ac

These rates are merely starting points and should be adjusted based on moisture conditions, soil type, method of seeding and comfort level. Other winter annual grasses that may survive the winter include winter wheat and winter triticale.

Section written by: Abbey Wick, NDSU

5 TIPS FOR *using cereal rye*

1. Depending on conditions, cereal rye can be seeded late into the fall with a majority of growth occurring in the spring.
2. Increase seeding rates with later seeding dates.
3. Bump up rates when broadcasting versus seeding.
4. Try variable rate seeding or broadcasting cereal rye on fields that have both sandy and high clay soils.
5. Terminate 14 days in advance of planting corn and never use cereal rye before a wheat or barley crop.

BLOWING *In The Wind*

Wind erosion of topsoil resources weighs heavily on the mind of farmers and educators. Topsoil is a non-renewable resource and contains organic matter and fertility that has been built naturally and also applied through the years. It is the highest quality material of the entire soil profile, and it is in the best interest of everyone to protect topsoil from erosion.

Estimates of how much soil is lost in our region to wind erosion are, on average, 5 tons/ac/year. This may not seem like much, but through time, this can lead to significant losses of a minimum of 1 inch of topsoil in 20 years. North Dakota State University conducted a study evaluating topsoil depth recorded in the 1960s against topsoil in depths recorded in 2014 from the exact same locations. In Walsh County, a total of 19 inches of topsoil was lost during the nearly 50 year time period.

Using cover crops and reducing tillage are effective ways to protect the soil resource from wind erosion. If efforts are made to reduce soil loss to wind erosion, water erosion also will be managed.

For more information, visit the North Dakota State University Soil Health webpage **ndsu.edu/soilhealth** and click on the video tab to watch several videos on erosion and management approaches suitable for our region.

WATER MANAGEMENT

Take a Drink

Cover crops got their start for most farmers trying to use excess moisture following a small-grain crop in a no-till system. For others, having an extra tool like a winter annual cover crop in place for using spring moisture when transitioning to reduced-till is a primary goal. Both goals are related to moisture management in reduced-tillage systems and require different approaches to get the job done.

With small-grain cash crops, moisture stops being transpired earlier in the season than other late-season crops. Any rainfall events following harvest fill the soil profile and can lead to wet conditions in the spring, especially if there is a thick mat of residue. Managing moisture following a small-grain crop relies on an entire system, so here are a few pointers.

First, cutting height at harvest to leave taller, standing residue and residue spreading evenly out the back of the combine are critical starting points. Residue management, like vertical tillage, may need to be used in some cases. Planting a cover crop consisting of low carbon to nitrogen ratios (such as dwarf essex rapeseed, radish or turnip) into the wheat residue can help break down the residue and use excess moisture later in the season. Consider adding 20 to 30 pounds of nitrogen to promote cover crop biomass and accelerate the system. Nitrogen added while planting cover crops should be captured by the cover crop and released again into the soil, although the timing of the release is not known.

Using a winter annual such as cereal rye (winter wheat or triticale) can be an excellent tool for managing spring moisture. The goal is to get cereal rye established in the fall so that it can start growing and using moisture in the spring before any equipment can get into the field. Having a living cover crop in the spring may also may help

with trafficability and timely access to the field. Keep in mind that a winter annual can use too much moisture and needs to be monitored closely in the spring prior to planting a cash crop.

Typically, radish or other high-nitrogen cover crops are not included for this goal of spring moisture usage because of the timing of seeding. If radish (or other cover crops) does not have enough time to grow and be cost-effective in the fall, then it should not be included in the mix.

Having an additional method for water management in the form of transpiration by plants in reduced-till systems is important. But again, keep in mind the entire system, the current crop being grown and the next crop in rotation to select the best possible cover crops to do the job.

Section written by:
Abbey Wick, NDSU

AgWeek Soil Health Minute

North Dakota State University Soil Health is featured on the Soil Health Minute with AgWeek TV and Magazine. Every other week during the growing season, Abbey Wick shows how farmers are incorporating cover crops and using other soil health-building practices to achieve on-farm goals. Additional information from each TV episode also are included in a column in AgWeek Magazine. The goal is to show farmers how the practices work and then follow up with more detailed information on integrating these practices on-farm.

Topics covered have included water and salinity management using cover crops, picking cover crops based on desired residue cover, cereal rye for weed suppression, interseeding corn, cover crops with sunflowers and evaluating soil health.

Videos and articles are posted on the North Dakota State University Soil Health webpage (**ndsu.edu/soilhealth**). The Soil Health Minute is sponsored by the North Dakota Corn Council and North Dakota Soybean Council.

BUILDING AGGREGATION *Add Some*

Soil structure provides a variety of services from environmental to logistical. Aggregation is just one component of soil structure that can be built by incorporating soil health building practices such as reduced tillage and cover crops.

Environmentally, aggregation improves water and air movement into the soil profile and also helps with water retention. Aggregates stabilize organic matter in the soil for release at different rates on the order of years to decades. Lastly, aggregates provide habitat for a diverse array of biological components in the soil.

Not all aggregates are created equally – different sized aggregates have varying levels of stability and serve different functions in the soil. A mixture of large and small aggregates is required to achieve desired benefits. Soil texture also plays a role: clay soils are more conducive to building stable aggregates than sandier soils. Both will build aggregates, but the stability of those aggregates and mechanisms for development varies greatly.

Large aggregates are created by fine roots and fungal hyphae (in particular, arbuscular mycorrhizal fungi) wrapping around soil particles (sand, silty and clay) and smaller aggregates, along with organic materials (dead roots and fungal debris, residue in varying stages of decomposition). Glues, called exudates, from roots and polysaccharides from biological communities, along with other binding agents, also are secreted, creating a "sticky string bag" to further stabilize the aggregate.

Large aggregates create large pores that are useful for water drainage and air movement into the soil and typically protect organic matter that is relatively new to the soil, meaning it has a higher carbon-to-nitrogen ratio. Smaller aggregates also are held within the larger aggregates, which protect more decomposed organic matter with a lower carbon-to-nitrogen ratio. Large aggregates also house a suite of microbial communities, typically dominated by microbes that utilize oxygen. In the smaller aggregates within the larger aggregates, microbes that function in environments with limited oxygen can be found. Incredible biological diversity can occur within one aggregate!

Large aggregates are most at risk based on selected farming practices. Typically, tillage is the most destructive because it rips apart the roots and fungal hyphae that help hold the large aggregate together. This exposes organic materials to oxygen and decomposition. When larger aggregates are broken apart, organic materials will be used by hungry microbes and lost to the atmosphere as carbon dioxide rather than being stored in the soil. With the introduction of tillage to soils in North Dakota, it was this release of organic materials is what provided an immediate, short-lived source of fertility, but it also led to the long-term decline in organic matter and reduction of other benefits provided by organic matter.

Small aggregates that exist on the outside of large aggregates are also important in the soil system, but are less responsive to farming

Structure

practices. They are formed primarily by clays and microbial glues that hold them together and protect a highly stable form of organic matter that remains in the soil for decades. Small aggregates create small pores in the soil that are important for water retention. This is why having a mix of aggregate sizes (large and small) is important for water management.

Logistically, aggregates help manage water for field access and provide a base for holding up equipment. Water will move down into the soil profile of an aggregated soil and make field conditions more desirable for equipment access. A stable, aggregated soil also will carry weight better than a soil that has un-aggregated primary soil particles (sand, silt, clay). This can be observed by walking into a field under no-till management and a field that has been tilled.

Cover crops play an integral role in building soil aggregation because fine roots, mycorrhizal associations and biological stimulation facilitate the building of aggregates. Including species in mixes that have fibrous roots and host arbuscular mycorrhizal fungi, such as most grasses, leads to roots wrapping around soil particles and providing organic materials to the soil to boost biological activity. Also including winter annuals will lengthen the time a living root is in the soil, providing better aggregation, root channels to support water movement into the soil, biological activity to make nutrients available and, ultimately, better trafficability and field access.

Section written by: Abbey Wick, NDSU

5 TIPS FOR *building aggregates*

1. Evaluate the different management practices being used to find out which works best for building aggregates in your soils.
2. Reduce tillage to keep large aggregates intact.
3. Increase the time of living roots in soil by using a winter annual to support aggregate formation.
4. Diversify mixes to provide multiple food sources to stimulate biological production of glues to stabilize aggregates.
5. Use shallow-and deep-rooted species in mixes to build aggregates throughout the soil profile.

CONSULTANT AND FARMER *Profile*

MARK HUSO
Lakota, N.D.

Mark is an independent crop consultant, starting Huso Crop Consulting and Soil Testing in 2011. He is based out of Lakota, N.D. and guides farmers on not only traditional practices, but also effective approaches to reducing tillage and integrating cover crops for his area. He sees the benefits of having roots to build soil aggregation and the use of a winter annual cover crop, such as cereal rye, to improve field access in wet conditions.

@husocrop

SCOTT HUSO
Aneta, N.D.

Scott farms near Aneta, N.D., raising wheat, barley, canola, pinto beans, soybeans and corn. Being reduced-till (including no-till, strip-till and vertical-till) since 2002 and using cover crops starting in 2015, he sees the benefits soil structure provides to his system but also values the multiple approaches used to achieve yield goals. He uses primarily cereal rye and radish in his cover crop mixes to keep it simple and economical.

@ScottHuso

WEED SUPPRESSION
A Little Competition

Cover crops can suppress weeds through competition for resources such as water, sunlight and nutrients. It's the idea of "pick your green or Mother Nature will do it for you," where seeding a cover crop can replace undesirable weed species and reduce weed pressures. The key to this concept is to pick a cover crop that can be controlled easily and keep the mix simple.

In many systems, cereal rye is being used as a tool to control early season weeds prior to planting soybean. Cereal rye establishes in the fall, overwinters and starts growing in early spring to compete with weeds that may establish prior to having desirable conditions for herbicide applications. The competition for resources, along with a strong allelopathic effect (chemicals leaked out of the cereal rye root that stunts weed growth), are a win for weed suppression.

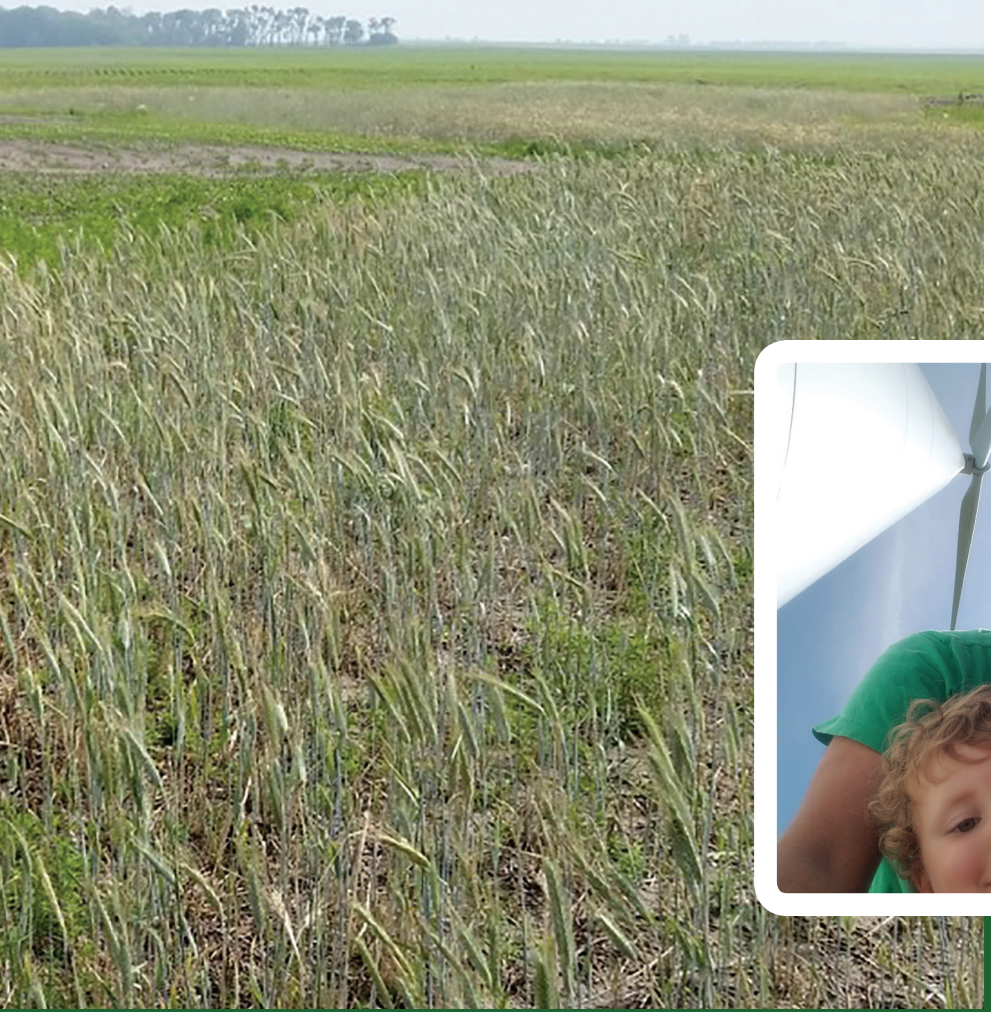
In studies conducted by North Dakota State University, weed biomass typically is 10 times less in areas where cereal rye is growing prior to planting soybean than in areas where there is no cereal rye is growing.

The "pick your green" principle is the same when using cover crops on areas with crop failure, including drown-outs and salt-affected areas. In these areas, using cover crop species that will not

cause issues with the cash crop currently growing or the next crop in rotation is important. For drown-outs, getting cereal rye established may be a good fit, whereas barley could be used on salt-affected areas. Problem spots typically harbor weeds, so getting a cover crop established prior to the weeds can be beneficial.

Integrating cover crops into a herbicide program for weed management is a solid approach to getting control of weeds.

Section written by: Abbey Wick, NDSU



FARMER *Profile*

LEE TRAUTMAN

Jamestown, N.D.

Cereal rye is king on the Trautman Farm. They have been growing cereal rye as a cash crop and using it as a cover crop by broadcasting into corn at side-dress using a custom-built unit. One main benefit they have seen as a result of using cereal rye is suppression of kochia and ragweed, both problem weeds in their area.

Lee started by seeding cereal rye at a 60 lb/ac rate and taking it to harvest. He then planted soybean into the volunteer cereal rye the following year. He was impressed with not only the weed control in using this approach, but also the moisture management.

The Trautmans variable rate cereal rye by broadcasting into their corn crop while side-dressing nitrogen, hitting the sandier soils on the hilltop with 10 lbs/ac and the higher clay soils in low areas with 60 lb/ac. Lee is hoping to find the sweet spot with moisture management by reducing water use in the spring on the hilltops and maintaining high water use in the low parts of the field, while at the same time using cereal rye as a mode of action for weed control in their fields.

@lee_trautman

BIOMASS FOR GRAZING
What's on the Menu?

Cover crops are a great forage resource for grazing providing a nutritious and delicious menu. A mixture of cover crops provides a balanced diet for cows with the proper nutrient content and digestibility. Also, a mixture has a lower risk of causing toxicity by toxic compounds.

Cover crop choices in a mix will vary with the time of planting (full season or fall grazing), location (dry or normal rainfall), soil health objectives, residual herbicides, type of cattle and nutrient needs.

Grasses: Cool- or warm-season grasses produce high tonnage. Grasses are low in protein but their fiber has higher digestibility than legumes. Cool-season grasses such as oat and barley are, in general, of better quality than warm-season grasses (forage sorghum, millet), but the latter produce more biomass. If you are planting cover crops in August or after, including only cool-season grasses is preferable because warm-season grasses won't have much time to grow before the first frost.

Legumes: They are high in protein content needed for muscle formation and milk production in the animal. The protein in legumes is mainly in the leaves. Stems have much lower protein content and are high in fiber, with digestibility of the fiber lower than that of grasses. For fall grazing, legumes with a fast growth rate and tolerance to frost are preferred. Faba bean is becoming a popular option because it can survive well into November and tolerate temperatures of 20 F. Clovers grow very slowly in the fall, providing little forage and are more suitable for a full-season cover crop mix.

Brassicas: Forage brassicas are a great addition to a cover crop mixture for grazing. They provide highly digestible forage with high crude protein and energy content. Brassicas are very high in ash and water content and low in fiber. If used as the sole feed, brassicas must be supplemented with fiber (dry hay, corn stover, wheat straw) to slow their passage. Brassicas in mixture with cool-season grasses work great because they complement each other.

Brassicas' tolerance to hard frost varies among species, with turnips and kales being more tolerant than radish and rape. Considering that forage production of brassicas varies greatly with species and even varieties within species is very important. Make sure to look for variety trials near your area before selecting a forage brassica for grazing: not all turnip or radish varieties have the same forage yield potential. Selecting a high-yielding variety adapted to grow in your area is crucial for a successful forage production.

All cover crops can be grazed if in a mix, providing a variety of nutrients. In a mix, possible toxins such as prussic acid, nitrates, sulfates or bloating compounds are diluted reducing the risk for animal toxicity. But be aware that the mix you planted might not have the same composition at the time of grazing. Assessing the composition of your mix at the time of grazing is important. Take a few samples to determine the proportion of each crop in the mix, and send it for testing if needed. In drought conditions, many plants can accumulate nitrate, which is toxic for animals.

Section written by: Marisol Berti, NDSU

FARMER *Profile*

ANDY AND MITCH HOENHAUSE

Lisbon, N.D.

Grazing cattle on cover crops is a common occurrence on the Hoenhause farm. They use cover crops in three areas of their rotation: following peas, following wheat and interseeded into corn. They also have been known to put some tough ground into a full season cover crop to improve the soils and have a high-quality material to graze.

Andy and Mitch will use whatever is sitting in the seed shed for their mixes, but most commonly they include radish, turnip, peas, winter wheat, oats or cereal rye in the mix. Interseeding corn with radish (2 to 3 lb/ac), turnip (1 to 2 lb/ac) and dwarf essex rapeseed (1 to 2 lb/ac) has given their cattle a good diet of protein for weight gain and fiber from the corn stalks to help slow passage.

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