

# Holistic Planned Cropping

## The Quest for a Continuous Live Root

by Ann Adams

As interest in cropping systems that build soil health continues to grow, those working with farmers who want to transition to such practices are finding new ways to help make those transitions more successful. HMI Certified Educator Joshua Dukart, who works for the Burleigh County Soil Conservation District and the North Dakota Grazing Lands Coalition, has been learning a lot from his colleagues and the farmers and ranchers involved in this soil health movement. Recently, he shared his thoughts about Holistic Planned Cropping and how to help farmers take their operation to the next level for improved profitability, land health and quality of life.

### REGENERATIVE CROPPING

“As we know it’s really about feeding the soil organisms,” said Dukart. “There are different techniques to build soil health and each operation and landscape is different. But, there are cover crops that can fit into a wide array of areas. Each place has a different set of challenges and opportunities that you need to work with. In Burleigh County we have 16 inches of rain on average, with May and June being the heavy precipitation months. We have a very short growing season, and we’ve found some techniques that work here and are working to adapt other techniques that have worked in other places. There’s still a lot of learning to do, but we also now have experienced farmers who can improve poor soils in as little as two to three years when it may take someone 10 to 20 years to do that with a trial and error approach using conventional tools.”

Dukart believes that conservation is not enough. Regenerative management is needed to create a sustainable future. Holistic Planned Cropping is a process that helps you determine which of the many tools available are right given the various parameters you are dealing with. People frequently ask him if cropping and Holistic Management work together.

In his opinion how people integrate the different tools, including Holistic Management, is on a spectrum. Some

people see annual cropping as bad and choose not to engage in the process because they believe it is ecologically not viable. However, just as in the case with grazing, Dukart believes it is how you do the cropping as to whether or not it is ecologically viable.

If we look at the low end of the spectrum of Holistic Planned Cropping, it starts with the conventional approach of tillage with low crop diversity. As you proceed across the spectrum of increased soil health, additional tools such as no-till, cocktail seeding and planned grazing allow for higher levels of management and potential benefits. Each tool adds additional complexity to planning and management, but the rewards are improved soil health, increased production, less inputs and greater profitability. Having the Holistic Management decision-making framework, Holistic Financial Planning, and Holistic Grazing Planning can help with making that transition. “I like to have people develop a biological plan that includes both their holistic grazing plan and holistic crop plan,” says Dukart.

The focal point in this process is developing cropping systems and rotations that mimic native grasslands’ ecological processes. You then are using that criteria to determine what the weakest ecosystem process is and develop cropping and grazing practices to strengthen it. The improvement of soil health (the investment)

### The Spectrum of Holistic Planned Grazing

- Tillage
- Direct Seeding
- No-till with low crop diversity
- No-till with high crop diversity
- No-till with high crop diversity and cover crops
- No-till with high crop diversity, cover crops and livestock

is balanced with the need for income generation (crops and livestock).

“If we are going to graze with purpose and intention and strategy, we can do the same with cropping,” said Dukart. “But we have to get beyond the conventional cropping methods out there. While Holistic Planned Grazing is about getting the animals to the right place at the right time for the right reasons, Holistic Planned Cropping is getting the animals *and* the seeds to the right place at the right time for the right reasons. There is an additional step because of the annual crop in the system. That’s not to say that the perennial plant shouldn’t be part of a crop rotation like pasture cropping.”

To build the soil, the focus is on soil cover (armor), diversity of plants, always



At Brown's Ranch as many as 300 yearling heifers are grazed on one-third of an acre as a tool to improve soil health.

Photos courtesy of Holistic Management International

Corn on Cover Crop	Cover Crop on Cover Crop
Total Biology – 1774 ng/g soil	Total Biology – 3312 ng/g soil
Bacteria – 1473 ng/g soil	Bacteria – 2510 ng/g soil
Fungi – 147 ng/g soil	Fungi – 513 ng/g soil
Mycorrhiza – 37 ng/g soil	Mycorrhiza – 251 ng/g soil

*Soil food web soil tests show the difference in soil health when comparing the soil life after corn (monoculture) is planted after a cover crop as opposed to a second polycrop planted after a cover crop.*

having a continual live plant root, creating appropriate disturbance and allowing for adequate recovery time for plants and soil life.

### SOIL WITH A LIVE ROOT

Pasture cropping has gained a lot of attention as a way to crop farm with a continual live root (perennial plants). It is the process of planting an annual cash crop into a pasture that has been recently grazed. For example, if you have a cool-season pasture, you would graze the forage then drill a warm-season annual cash crop, such as millet, so that it would be able to come up while the cool-season plants are dormant. You would then harvest the oats and then allow animals in to graze the residue before starting the cycle again. But the short growing season and the relatively quick switch from cool- to warm-season in Burleigh County makes this technique challenging and is still in the investigation stage.

Dukart notes that cover crops can help make the transition to higher levels of soil health more successful:

“With holistic planned cropping, cover crops become a flexible and dynamic tool. We start the planning process looking for a shorter-season annual crop in the rotation, a crop like peas and small grains, so we still have some growing season left. The cover crop is planted right after the annual crop is harvested. This can work well, but does depend some on how degraded the soil is and how the ecosystem processes are functioning. Some people prefer to use a full-season cover crop as a regular part of their crop rotation. This approach, especially in the first years, is more likely to be successful; utilizing more reliable spring moisture and creating larger amounts of available forage for livestock. With full-season cover crops you get greater expression of the plants above the ground and rooting expression belowground. We encourage people to use a five to eight-plus annual species mix. Some farmers will then graze the

crop while others will hay it or simply roll the material onto the soil surface. It’s always a balance between income and investment. You can take income off the cropland by grazing and prepare the soil for the next annual crop. You do this with less machinery passes, and inputs that are all getting more expensive.”

Dukart notes that producers and agricultural researchers are beginning to experiment with a variety of techniques to address the soil resource issues in the region including identifying cover crop and annual crop species that will work for their short growing season and winters.

Perennials are being considered as a tool for the future in their cropping management. Currently they are looking at ways of utilizing the concept of pasture cropping, but adapting the principles to the northern Great Plains. They have found they can extend that growing season with increased biological health. They are experimenting on a small scale so risk is small. “If you are interested in using these cocktail mixes, start on a small scale,” says Dukart. “Go with a full-season route for cover cropping as a starting point. If you have a longer growing season then you can consider double cropping, therefore growing an annual crop and a full-season cover crop.”

The lowest organic matter that they have successfully begun building soil health with cover crops has been in the 0.8 to 1.2 organic matter range. With these techniques they have been able to get the organic matter up to 2.5-3 percent on lighter sandy type soils. Experiments have shown that the diversity of crops creates different results. Research also shows that there is a 7:1 improvement and efficiency of use of moisture through cocktail seeding.

One farmer, Ken Miller from Fort Rice, North Dakota, tried a cover crop cocktail following a biennial crop of winter triticale harvested with grazing. The cover crop cocktail was seeded at the beginning of August with temperatures over

100°F. He planted seven different species. Even though it was very dry conditions in which he received only 2 inches of rain after seeding, he grew approximately 4,000 pounds of forage per acre. Dukart has found that after you build soil health there is opportunity for growing forage — particularly if you have good soil cover.

“I can’t emphasize enough what a significant role soil cover plays,” said Dukart. “After that there is the need for diversity. We like to see people planting all four different crop types (cool season grasses and broadleaves and warm-season grasses and broadleaves). Each plant can address diet deficiencies for soil organisms so these cover crops are like biological primers for the soil.”

The importance of covered soil and diversity of species was demonstrated in 2006 on the Burleigh County Soil District demonstration plot. After a very dry summer when only 1.5 inches of rain fell, the area where there was a single species of oilseed radish planted had a soil temperature of 107°F. In contrast, the area where there was a cover crop of seven different species (including oilseed radish) the soil temperature was 87°F due to much greater growth of plants and more soil cover. This 20-degree difference provides a much better home for soil organisms.

“There are all these different species under soil,” says Dukart. “We can see earthworms and dung beetles. But we can’t see the other creatures like bacteria, fungi, nematodes and protozoa, so we don’t give them attention even though the role they play is really important.”

### PRODUCTION PLANNING

For graziers, planning a full forage chain is critical for a profitable business. They need to make sure that every time period of the year is covered with some crop/forage that can be grazed. “While many people understand this for feeding animals above the ground, we need a total mix ration for our soil microbes for the entire year too,” says Dukart. “We are looking to create an environment with a continuous life root in the soil that helps take solar energy into the soil to grow roots to feed microbes and then benefit from their free labor. Many annual crops only use part of the growing season, leaving the land without a live food source for part of the growing season. On top of that, the soil organisms were only fed one thing on the menu for a short time. The microorganisms need a home and food. Our production planning needs to take

that into account. We need to feed the soil biology and the livestock. Livestock is the short economic return and the soil biology is the long-term investment.”

According to Dukart, once you get the ground covered and have diversity, you should then determine what the appropriate type and timing is for soil disturbance. Your two key options are animals (grazing and animal impact) or technology (cutting, crimping, etc.). Biological planning should then allow for maximum flexibility for type and timing. Using the Holistic Planned Grazing Chart to integrate both crop and livestock usage of areas can help with that integration.

One example of this type of Holistic Crop Planning is Brown’s Ranch located near Bismarck, North Dakota. “These folks are ranchers first,” said Dukart. “They are using some of these techniques to biologically prime the land. They planted cover crop mixes that were quick growing and aggressive rooting to help them deal with soil health issues. They don’t take this directly back to grass; they use diversity of annual crops in mixes to reestablish the water and mineral cycles for a couple of years before reseeding grass. We also know that the harvesting method does matter.”

At Brown’s Ranch they tried two methods of harvesting a warm-season cover crop planted in 2007.

Harvesting Method Comparison	
Grazing 2007	Chopping 2007
91 bu/acre corn (’08)	68 bu/acre corn (’08)
1 herbicide application	2 herbicide applications
Value of additional nutrients of manure	Value of nutrients hauled away?

“In 2007 they grazed half of the field. The other half of the field they mechanically chopped. In 2008 they found that the side that had been grazed needed one less application of herbicide when they planted the following year. And, the amount of production on the grazed side was 91 bushels/acre versus 68 bushels to the acre where the crop had been chopped. Overall plant resiliency and quality was much higher on the grazed side. For this reason cover crops and mob grazing are part of the normal rotation on Brown’s Ranch.”

After determining the appropriate disturbance mechanism, the final step is to determine appropriate recovery. “When we think about recovery we usually look at plants as the main indicator,” said Dukart. “But we need to not just consider the plant but also the soil and microorganisms. We need to consider the most severely impacted biological item, or issue, whether that is an insect, animal performance, compaction, etc.”

The key is to always monitor. Timing of grazing on cropland is just as critical as on perennial grassland.

“If we are using higher stock densities and larger numbers of animals there is less room for error, but much greater potential benefits. Compaction can be a concern, but not nearly as much if animals are moved regularly. One of the best and easiest ways to monitor is to go dig around in the soil with a shovel. We go out to the field with a shovel after a rainfall event, a grazing event, a mechanical harvesting event, etc. to see what impact it had on the soil. We’ve also seen that compaction becomes less and less of an issue with high levels of soil health supported by soil cover, diversity, and a continuous live root helping support the above-ground weight.”

“You can also use soil testing of the biology (bacteria, fungal, protozoa) to look at the trends. We test before, during and after different production techniques to see how the populations were affected and if they have returned in greater numbers. We’ve used Ward Labs out of Kearney, Nebraska. We’ve also used Rick Haney

at the Agricultural Research Station in Temple, Texas, to look at soil health indicators. With this kind of monitoring we are able to make better decisions. Another monitoring technique I use for testing for compaction is to take a small tree flag as I step across a field. I can poke it in as I walk and feel the resistance. Of course it’s always good to do photo points as well. Pick the monitoring practices that will give you the best information about the most severely impacted biological issue.”

Another ranch using Holistic Crop Planning is the Black Leg Ranch near McKenzie, North Dakota. The Doan Family has a number of different enterprises but began as a cow/calf operation. Jerry and Renae Doan encouraged the new generation to bring new enterprises back to the ranch when or if they decided to return. They have been developing their wildlife habitat and guiding enterprise and then adding agritourism into the mix.

“Cropping is not their main focus but they are using cover crops to enhance their ranch,” said Dukart. “They are also constantly telling their story and educating others about how they are bridging the gap between their grazing and cropping. Their cropland serves as the resource base to grow cover crops as wildlife habitat and to supply a winter feeding/ grazing option for their cow herd. Stacking enterprises has created efficiency and opportunity on their ranch.”

### CREATIVE SOLUTIONS

There are some key questions to ask when designing a cocktail mix as well as determining other management techniques to incorporate into your holistic crop plan such as types of disturbance and recovery periods for plants and soil organisms. Just as in holistic grazing planning, you want to keep your future landscape description in mind and inventory current production capabilities as well as determine what your desired production goals are for the year and for the next three to five years. By knowing what your short, medium and long-range objectives



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*When seeding a cocktail mix, the key is to have cool- and warm-season grasses and broadleaf plants to feed a variety of soil organisms.*

are for your landscape and your business, you are better able to select management techniques that can balance the needs of all these objectives.

One tool that Dukart finds helpful in helping determine which crops to plant is the Addressing Resource Concerns worksheet. By determining what the key resource concerns are, then he can begin suggesting crops that will address those concerns. For example, if someone is having issues with needing some nitrogen in the mix then legumes are an obvious choice. But, there may also be issues with compaction in which they need some root depth, or they may want to provide more habitats for pollinators or build more carbon in the soil. By listing the various species and what they can contribute to the resource concerns, farmers can develop a more effective cocktail mix for different fields that have different issues.

Trying to integrate cropping and grazing doesn't mean that producers need to do it all. Dukart talks about the benefit of a cash grain producer collaborating with a rancher to utilize cover crops and grazing to create a win-win situation. These are the kinds of creative solutions that will help take this type of agriculture to the next level. The livestock producer also needs to be flexible in their production schedule to accommodate the grain producer. For example, if the cow herd calves in May and June then the cows can handle grazing residue in January and February when the grain farmer may need that grazing done. At the Blackleg Ranch they are able to graze a cover crop into March during mild winters and until January in more severe winters — by do-

ing so they can save up to \$50,000 a year in feed costs.

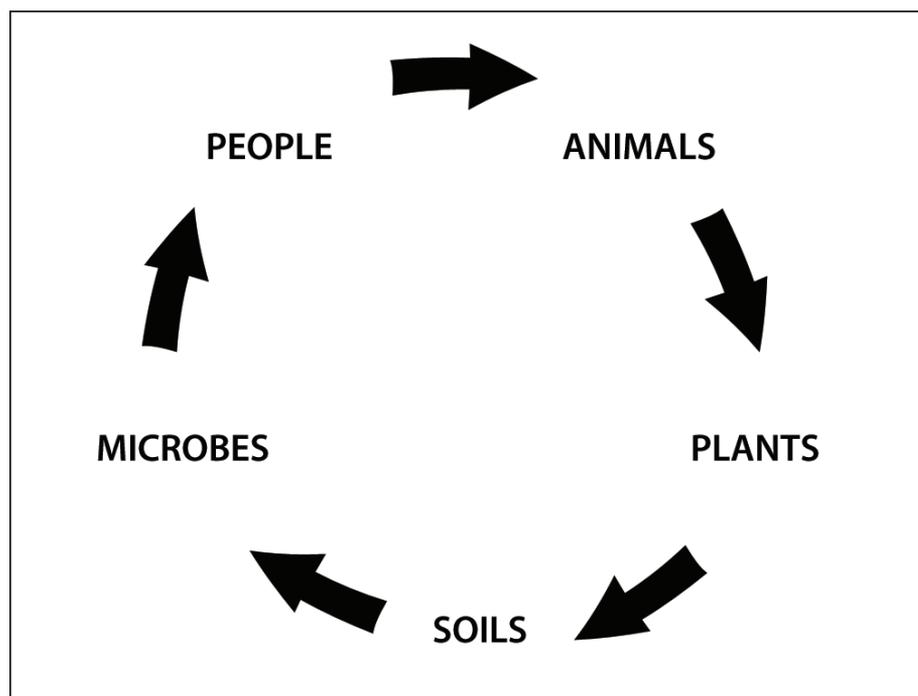
For many ranching operations, the original homestead was built close to water. They were often located in a valley or near a spring. A lot of cows would get wintered along a creek which may not have been the best practice for those riparian areas or water quality. With new technology there is the ability to manage these animals through planned moves on croplands and rangelands, providing benefit to the land and taking away detrimental effects to water resources. For this

reason water quality is one of the things that should also be monitored.

The result of integrating planned grazing as a form of disturbance that drastically increases soil health has been documented on the Brown's Ranch in Burleigh County. They are planting a variety of poly-seeded biological primer cover crops and have grazed up to 300 yearling heifers on the mix, giving them about one-third of an acre as a paddock and moving the herd several times a day. Soil food web tests show that the bacteria:fungi ratio and soil organic matter differs dramatically on areas where there has been mob grazing added to the mix versus when there has been no mob grazing.

Likewise, resilience in the soil has been demonstrated with the ability of the soil to absorb large amounts of rain due to good crumb structure and large quantities of glomalin, the soil glue that supports that crumb structure. The healthy soil also results in excellent crop yields and reduced need for herbicides and fertilizer, thus increasing the Browns' financial bottom line. Based on soil and tissue tests it is clear that the soil is producing its own nutrition.

In this way soil health and cover cropping makes creating profit easier. "When you get excited about what soil can produce it encourages even better manage-



*For an effective holistic biological plan you need to consider the entire cycle of biological activity.*

## Brown's Ranch (Native Rangeland SOM: 7.2)

Two Years Mob Grazing West Side of Shelterbelt	No Mob Grazing East Side of Shelterbelt
Total Biology: 6105 ng/g soil	Total Biology: 4228 ng/g soil
Actinomycetes: 213 ng/g soil	Actinomycetes: 418 ng/g soil
Bacteria: 4417 ng/g soil	Bacteria: 3349 ng/g soil
Fungi: 786 ng/g soil	Fungi: 386 ng/g soil
Ratio Bacteria/Fungi: 5.6	Ratio Bacteria/Fungi: 8.7
Mycorrhiza: 230 ng/g soil	Mycorrhiza: 145 ng/g soil
SOM: 5.0	SOM: 3.8

*Soil food web tests show that the bacteria-fungi ratio and soil organic matter differs dramatically on areas where there has been mob grazing added to the mix versus when there has been no mob grazing.*

ment and creativity,” says Dukart. “Your biological plan, which includes both holistic crop planning and holistic grazing planning, is clearly tied to your financial plan which is tied to your holistic goal.”

When asked what concerns producers have about shifting to this type of cropping, Dukart notes that people are concerned about how they can effectively polyseed a field. “Many people are experimenting with the most effective way to drill a poly crop. Some producers have had trouble with small seeds sifting to the bottom as the seeder moves across the field if they put everything into the same box and if they are seeding a lot of acres at a time. The easiest solution is to seed in smaller batches of approximately 50 acres or less in order to get good distribution of diversity across the field. If you have the option of multiple boxes, then you can separate out the different seed sizes. Producers have found that a depth of three-quarters to 1 inch works for most species even though that is somewhat shallow for some species and fairly deep for others.”

“People are also concerned that while no-till or polyseeded cover crops or pasture cropping works in some areas of the world, it won't work in their area. We have seen these different techniques work in climates with very low rainfall (less than 8 inches) to very high rainfall (more than 50 inches). It needs to be adapted for each environment. The thing to remember is that it may seem like you are going backward first, but cover crops can ultimately help us get through those transition periods quicker. Available moisture is just one part.”

No-till is just one tool with livestock as a disturbance mechanism. “Most areas where we talk about rotation of corn then soybean can be a mining of soil,” said Dukart. “This is not really a rotation at all and lacks diversity. You need more complexity to build soil health and we haven't even scratched the surface of practices that can help. You need a mindset of what you want to create. Many producers are seeing the writing on the wall with the high cost of inputs. Those with deeper soils can get away with mining their soils longer, but it's a house of cards. Right now with crop insurance there is not a lot of incentive to change except for your personal belief.” Those that are really interested in building a regenerative cropping system are leading the effort.

“Polygrain cropping is probably the easiest type of cropping in which to integrate livestock. The Browns did experiment with a polyseeded vegetable garden and got good results,” said Dukart. “However, from a Good Agricultural Practices (GAP) standpoint, in which there are large lengths of time required between the time livestock have been in a field and when vegetables can be planted, you have additional challenges for vegetable crop producers. Certainly the scale of the enterprise will determine which livestock to use. On smaller farms, the livestock of choice might be sheep, goats or poultry. You also may need to partner with folks who have the animals if you don't. Not everyone has to have their own equipment or animals. This type of farming may require more collaboration.” So if you need to schedule breaks in the crop-

ping so pathogens can be transformed through the decomposition process, you may need to create rotations either with other farms or on your own farm where you alternate between livestock production and cash crop production.

“Tillage is a challenging issue in cropping. We know it wipes out the soil biology's home, burns up organic matter, tears apart mycorrhizal communities, collapses soil structure and stagnates true infiltration,” said Dukart. “However, once a system reaches a higher successional stage, all soil items tend to balance and come into line. Many organic producers would prefer not to till, but currently it may be the best method for weed control for them. They also may put in a green manure crop and plow that in before they go in with a grain crop. Some are getting sequences where they don't use tillage as there is so much concern about soil structure and how it affects the water cycle. We need to continue to work at eliminating both tillage and bio-cide use as much as possible. Just like we have accepted a degraded soil resource, we tend to just accept some tools, even if we know they are damaging in some ways.”

Root crops are also a big challenge because of the level of soil disturbance necessary for harvesting. One producer who grows root crops on a commercial scale still digs his potatoes, but that is the only soil disturbance. He is looking at using a rotation to help with that disturbance not happening in the same place every year.

“There are still a lot of unanswered questions, but we know a lot more than we did 10 years ago,” said Dukart. “Gabe Brown said that he believes that with the knowledge he now has he could turn most farms around biologically in three to five years. The focus has to be on the whole biological plan that is feeding the soil and providing income. You can't manage for any one thing and maintain balance. Balance is the key with holistic crop planning.”

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