



GRAZED COVER CROPPING: DREW LEITCH

FARMER-TO-FARMER CASE STUDY SERIES: INCREASING RESILIENCE AMONG FARMERS IN THE PACIFIC NORTHWEST

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Grazed Cover Cropping: Drew Leitch

By

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Abstract

Drew Leitch, whose farm in Nezperce, Idaho receives between 17 and 23 inches of precipitation annually, has been experimenting with using cover crops in his dryland wheat rotations and has achieved promising early results by integrating spring-seeded cover crops into his cow-calf operation. In this [video](#), “Grazed Cover Cropping—Drew Leitch,” he describes his experience.

This case study is part of the Farmer-to-Farmer Case Study project, which explores innovative approaches regional farmers are using that may increase their resilience in the face of a changing climate. Case study information presented is based on growers’ experiences and expertise and should not be considered as university recommendations. Mention of trade names or commercial products is solely for the purpose of providing specific information and does not imply recommendation or endorsement.

Grower quotes have been edited slightly for clarity, without changing the meaning.

Readers interested in other case studies in this series can access them on the [REACCH website](#) or in the [WSU Extension Learning Library](#).

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Grazed Cover Cropping: Drew Leitch



Photo: Darrell Kilgore

Location: Nezperce, ID

Average Annual Precipitation: 17–23 inches

Cropping System: Dryland crops, including winter and spring wheat, Kentucky bluegrass, spring canola, garbanzo beans, peas, and lentils. Experimenting with spring cover crops as cattle forage and fall cover crops.

In this companion video, [Grazed Cover Cropping—Drew Leitch](#), he discusses his motivations for, and experience with, grazing cover crops.



Map: Kaelin Hamel-Rieken, Washington State University

Introduction

Drew Leitch grows dryland crops that include wheat, Kentucky bluegrass, spring canola, garbanzo beans, peas, and lentils in Nezperce, Idaho, on the Camas Prairie. Although his area receives more precipitation than many parts of the Inland Pacific Northwest, water is still a primary limiting factor, particularly in mid to late summer. The farm’s 2500 acres of cropland primarily consist of silt loam soils (Uhlorn Silt Loams, Uhlorn-Volmer Complex Silt Loams, or Uhlorn-Nez Perce Complex Silt Loams; NRCS 2004) that are variable in depth. Elevations of 3300 to 3800 feet on the prairie create a relatively short, cool growing season.

In addition to raising dryland crops, Leitch also manages a 125-pair cow-calf operation. His cows calve in late summer or early fall, and calves are fed hay through the winter and then sold the following July or August when they reach 800 to 850 pounds. In the spring and early summer, the animals graze about 3000 acres of pasture land that is not suitable for crop production. As Leitch says, “The limiting factor for me in my cattle operation is the pasture. Beginning in late June, it starts turning [brown] and then I start losing food value so the animals don’t do as well.” Experimenting with cover crops came from the desire to improve both sides of his operation, improving soil health on his cropped acres and extending his grazing resources (Figure 1).



Figure 1. Cattle grazing on cover crops in early July 2015. The mix shown here includes forage oats, triticale, beardless barley, spring peas or lentils, and some brassicas. Leitch has since removed triticale from his mixes to avoid having it volunteer and contaminate his following wheat crop. Photo: Darrell Kilgore.

Building Soil Health with Crops and Livestock

Since he started farming more than 20 years ago, Leitch has been using direct seed practices to build soil health. Over this time, he has observed slow but steady gains in soil organic matter, as evidenced by soil testing results across the farm. Experimenting with cover crops was prompted by a desire to extend those efforts to build soil health via the living roots and cover crop residues that remain after grazing—as well as a desire to enhance his grazing resources. The plants that comprise the cover crop mix also add diversity to his rotation and help address specific soil health issues such as compaction. During grazing, manure also gets incorporated into the soil by the livestock as another form of organic matter.

In 2012, after hearing about successful use of cover cropping in the Midwest, Leitch agreed to collaborate with University of Idaho Extension and explore how similar approaches might be adapted to dryland regions of the Pacific Northwest. That spring, he began hosting a 23-acre test plot featuring



Figure 2. Cattle grazing the cover crop strip trial in August 2013. Photo: Doug Finkelnburg.

spring- and fall-planted cover crops, with goals of exploring their suitability for grazing (Figure 2) and their effects on the growth of the following crops. (For additional description of these trials and the results, see the sidebar *Demonstrations of Cover Crop Mixes and Grazing in a Dryland Northern Idaho Direct Seeded Annual Crop System*.) In 2013, he signed a USDA-NRCS EQIP contract that allowed him to grow fall-planted cover crops on another portion of his land. The contract covered part of the seed costs while supporting his investigation of a new practice.

Leitch still considers himself to be early in the cover crop experimentation process. His hope is that extending the time with living plant cover on the soil will supply nutritious animal feed during summer growing months while protecting the soil, building organic matter, supporting a beneficial community of soil organisms, and improving the soil's resilience to stress. Leitch is also interested in learning whether improved soil health can help mitigate other concerns, such as reducing the rate of soil acidification. (For more on soil acidification in the Inland Pacific Northwest, see the sidebar *Acidifying Topsoils and Associated Risks to Dryland Crop Production*.)

Cover Cropping Systems

Leitch chooses to plant a diverse mix of species in his cover crops. His mix usually includes at least one brassica, one legume, and several annual grasses, such as oats or wheat. Brassica cover crops, such as canola or radish, have large taproots that can penetrate the soil and reduce compaction. Legumes, such as black pea and lentil, can add nitrogen to the soil through biological fixation. Grasses, like oats and wheat, retain nitrogen and reduce leaching while supplying large quantities of crop biomass.

Spring Cover Crops

Leitch's spring-seeded cover crops are usually planted in April or May for summer grazing. When selecting cover crops, he chooses varieties that stay green longer into the summer, have good regrowth after grazing, winter-kill in fall, and are unlikely to become weeds. For more information on his mix, see the sidebar *Cover Crop Species for Forage Quality and Soil Health*. In the last few years, his spring cover crop mix for grazing has included Everleaf oats (a forage oat that grows continuously throughout the

Demonstrations of Cover Crop Mixes and Grazing in a Dryland Northern Idaho Direct Seeded Annual Crop System

Doug Finkelnburg, University of Idaho Extension

Ken Hart, University of Idaho Extension

James Church, University of Idaho Extension

In 2012, USDA-NRCS, Lewis County Soil Conservation District, and University of Idaho Extension implemented a demonstration and research project at the Leitch farm to explore the potential use of cover crops in a direct-seed annual grain production system common in north central Idaho. The goal was to evaluate the effects of fall- and spring-planted cover crop mixes on subsequent crop performance and to explore the potential of using cover crop mixes as a forage within these rotations.

In the fall-planted cover crop trial, two different cover crop seed mixes were compared to fallow (Table 1). Results from 2012 to 2013 showed that a nitrogen mix had no significant impact on the yields of subsequent spring canola compared to fallow, while a soil enhancement mix had a negative impact (Table 2).

The spring-planted cover crop trial used three different cover crop mixes, with performance again compared to fallow (Table 3). However, in this trial, half of each plot was grazed while the other half was not. Winter wheat following the nitrogen mix yielded 14% more than winter wheat following fallow. Other mixes did not significantly impact yields of winter wheat (Table 4). The presence of cow-calf pairs on spring planted cover crop mixes (including fallow plots) boosted following winter wheat yields, but the causes of this observation were not well understood and would need to be verified with additional research. For complete results and discussion see Finkelnburg et al. 2016.

Table 1. Fall-planted cover crop seed mix planting rates (pounds/acre).

Species/Variety	Nitrogen Mix	Soil Enhancement Mix
	pounds/acre	
Winter Pea	12.5	5.2
Winter Lentil	4.5	1.9
Common Vetch	4.5	
Red Clover	1.3	0.5
Crimson Clover		0.7
Winter Oats	15.0	6.2
Hairy Vetch		1.0
Winter Triticale		6.2
Spring Barley		6.2
Purple Top Turnip		0.4
Nitro Radish		0.6
Winter Canola		0.6
Rapeseed		0.4
Cover Crop Mix	37.8	29.9

Table 2. Spring canola yields following two fall-seeded cover crop mixes.

Cover Crop Effects*	Yield (pounds/acre)	% Difference from Fallow
Nitrogen Mix	1795 a	+1
Fallow	1783 a	0
Soil Enhancement Mix CV, 2.5%	1682 b	-7

*a is different from b at a 0.05 probability level.

continued

Table 3. Spring-planted cover crop seed mix planting rates (pounds/acre).

Species/Variety	Nitrogen	Grazing	Soil Enhancement
	Mix	Mix	Mix
	pounds/acre		
Spring Forage Peas	16.0	8.9	5.3
Spring Lentils	4.5		
Common Vetch	4.5	2.5	
Rapeseed	1.0	0.6	0.3
Flax	5.5		
Crimson Clover		0.9	0.5
Everleaf Oats		8.3	8.3
Spring Barley		8.3	5.0
Appin Forage Turnips		0.6	
Groundhog Forage			
Radish		0.8	
Pearl Millet		1.1	1.1
Soybean			1.8
Winter Pea			4.2
Hairy Vetch			0.8
Spring Triticale			5.0
Purple Top Turnip			0.3
Nitro Radish			0.5
Pacific Gold Mustard			0.5
Sunflower			1.3
Buckwheat			2.3
Cover Crop Mix	31.5	32.0	37.2

Table 4. Winter wheat yields following three spring-seeded cover crop mixes and grazing.

Cover Crop Effects*	Yield (pounds/acre)	% Difference from Check
Nitrogen Mix	72 a	+14
Soil Enhancement		
Mix	68 ab	+9
Fallow	62 b	0
Grazing Mix	61 b	-2
Grazing Effects**		
Grazed	75 a	
CV, 10.3%	56 b	

*a is different from b at a 0.05 probability level.

**a is different from b at a 0.001 probability level.

Acidifying Topsoils and Associated Risks to Dryland Crop Production

Doug Finkelnburg, University of Idaho Extension

Kurt Schroeder, Department of Plant Sciences, University of Idaho

Agricultural topsoils in northern Idaho have been growing increasingly acidic due to years of application of acidifying fertilizer formulations, particularly ammonium-based fertilizers. If this continues, important rotation crops in wheat-based cropping systems that are sensitive to acidic soil conditions, such as grain-legumes and alfalfa, are likely to become less viable. This would increase risks to producers, because non-wheat rotation crops benefit wheat production by reducing disease pressure and increasing the amount of water available for subsequent fall wheat crops compared to following spring or fall wheat.

The last survey of northern Idaho agricultural soil pH was published in the 1980s (Figure 10; Mahler et al. 1985) and helped create interest in the application of agricultural lime. However, limited lime availability, high costs, and lack of research relating to the efficacy of particular types of lime in regional systems created an atmosphere in which little liming was done. Recent interest in soil health and documentation of aluminum toxicity and reduced yields has led to a renewal of interest in liming.

In 2014 and 2015, University of Idaho led a regional soil pH survey to assess topsoil pH and explore interactions between soil characteristics and yield limiting factors, including plant available aluminum and low base saturation. The Leitch farm is located on the northern end of the Camas Prairie of Idaho, a region suspected to be at risk of low pH due to the historic wheat and grass seed rotations that required intensive use of ammoniacal nitrogen fertilizers. Results from the survey indicate area agricultural topsoils in northern Idaho more acidic than they were three decades ago. The majority of fields sampled had topsoil pH levels known to limit yield potential for grain-legumes.

Additional information about pH issues and potential management strategies is provided in Borrelli et al. 2017.

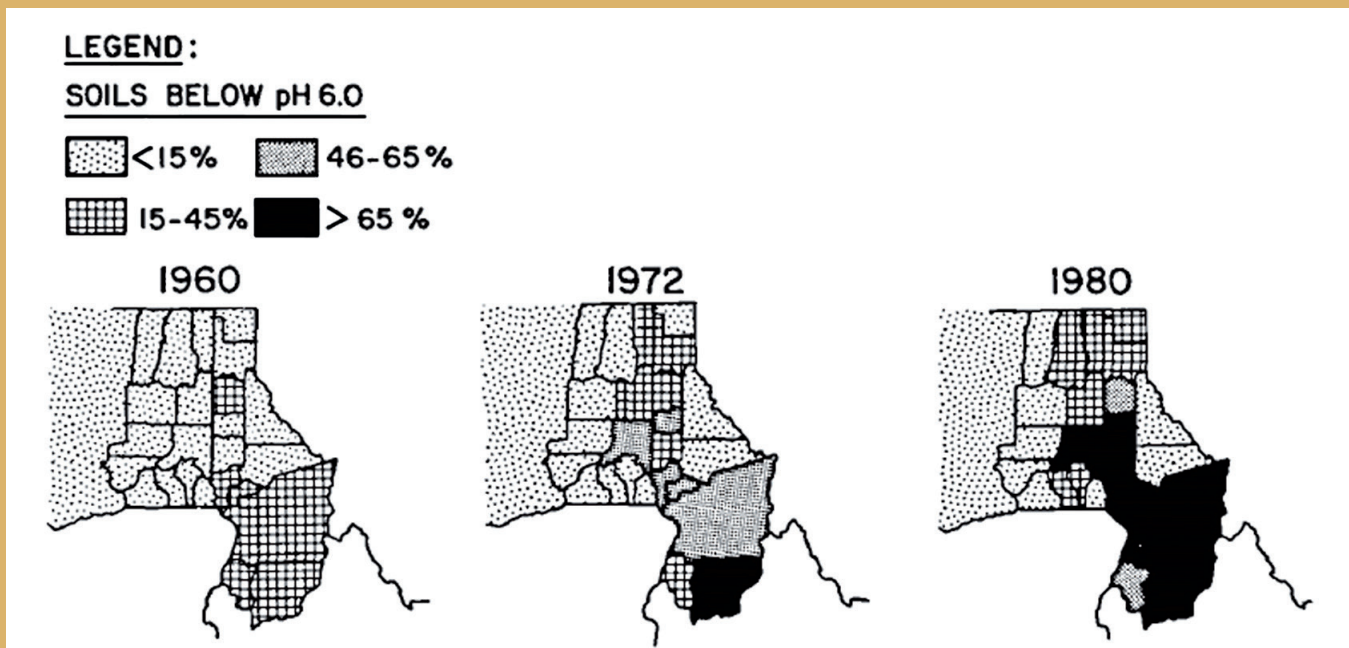


Figure 10. Percentage of soil samples with soil pH below 6, by county in northern Idaho and eastern Washington for three time periods (Mahler et al. 1985).

Cover Crop Species for Forage Quality and Soil Health

James Church, University of Idaho Extension

For grazed cover cropping, Leitch has used a six-species mix consisting of triticale, forage oats, spring canola, spring peas, forage radish, and forage turnips (Figure 10; he has since eliminated triticale due to issues with triticale volunteering and thereby contaminating his following wheat crop). This mix was developed through consultation with the University of Idaho Extension faculty and Lewis County Natural Resource Conservation Service personnel. Information from cover crop grazing research conducted in North Dakota was referenced to identify the six-species mix.

Species in the mix were chosen because they provided both soil health benefits and forage quality advantages. Triticale and forage oats were included because of their rapid growth, forage volume, forage quality, and palatability for the cattle. Spring canola was chosen for the soil health benefits and the volume of forage produced along with forage palatability. Spring peas fix nitrogen and are very palatable to cattle, providing a high protein forage. Forage radish and forage turnips, also very palatable, benefit the soil health with root systems that break up hardpans and enhance water and air infiltration.

Forage production from this mix provided over three tons of forage per acre. Quality analysis tests taken at several locations at turn out time in late June showed that the forage contained crude protein levels ranging from 16% to 19% and total digestible nutrients (TDN) levels ranging from 56.9% to 58.5% (Church, unpublished data). This is very good feed for cows nursing calves, for the calves themselves, and for yearlings. The cattle had excellent gains and performance on this forage.



Figure 11. Leitch's spring-seeded cover crop mix in July 2015. The mix shown here includes forage oats, triticale, beardless barley, spring peas or lentils, and some brassicas.

summer), beardless barley, spring peas or lentils, and a variety of brassicas, including canola, forage turnip, and forage radish (Figure 3). He thinks that this diverse mix is good for his cows. “You have some grain, the cows seem to love eating it, and different crops mature at different times, which means it provides forage over a longer time period.” Originally, he included triticale in the mix as well but has since eliminated it, because triticale tended to become weedy in the following wheat crop.

In addition to this mix, Leitch has also been planting some smaller areas to Sudan grass, a warm season grass that stays green longer and provides forage through August.

Grazing Spring Cover Crops

During grazing, animals are secured with portable electric fence while they rotate through one section of the field at a time. Leitch uses management intensive grazing, moving the animals every five to seven days. He aims for approximately one cow-calf pair or three 600-pound animals per acre. “Initially they flash graze over the green stuff, and then they’ll slowly work their way back to the drier stuff that has still got high [feed] value, but it’s just not nearly as tasty.” He only grazes about half the cover crop biomass he grows in order to meet the terms of his EQIP contract and to balance feeding the cows with his soil health objectives.

To extend the cover crop grazing period and maintain forage quality, the cover crop is managed three different ways. First, he grazes cattle on the green and growing crop. Second, when the crop reaches optimal maturity, he swathes ungrazed portions of the field to maintain nutritional value and allows the cows to graze the swathed windrows (Figure 4 and Figure 5). Finally, any remaining cover crop forage is baled and fed as hay later in the season (Figure 6).

In most years, a late summer or early fall rain stimulates regrowth, and he can directly graze the spring-planted cover crop again in the fall. This further delays the time when he needs to begin feeding hay, reducing a substantial expense for his cow-calf operation.

It is important for the animals to have access to water and shade, and Leitch hauls water in when



Figure 3. Leitch’s spring-planted cover crop mix in early July 2015. Photo: Darrell Kilgore.



Figure 4. Swathed cover crop ready to be grazed in windrows in early July 2015. Photo: Darrell Kilgore.



Figure 5. Cattle feeding on swathed cover crop in late July 2015. Photo: Doug Finkelburg.



Figure 6. Baled cover crop forage (July 2015) will be fed to cattle later in the season and will reduce Leitch’s substantial hay costs. Prior to implementing cover cropping, cattle were generally fed hay for six months each year. Photo: Darrell Kilgore.



Figure 7. When a pasture is not adjacent to a water source, Leitch uses a water truck and large diameter hose to provide water to animals. Photo: Doug Finkelnburg.

they do not have easy access to a stream (Figure 7). As an added benefit, “the animals get used to seeing me and knowing who I am so that it’s easier when it comes time to round them up or work with them if I have a sick animal.” Providing shade has not been a problem. “If you turn them out into a new green paddock of cover crop, they have some really nice places to lay. The cover crop is about four feet tall, so they can find some shade even within any spot that they lay down.”

Fall Cover Crops

Like most dryland growers in his area, most of Leitch’s acreage is planted to winter wheat in any given year. Following winter wheat, land would typically be left fallow before planting a spring crop, but Leitch has been planting fall cover crops to build the soil. These cover crops continue to grow until April and then are terminated with an herbicide prior to planting spring crops.

For the cover crop to produce significant growth and sufficient biomass to protect the soil over the winter, it is important to plant it as early as possible. In the last few years, this has meant having the seed flown on prior to harvesting the previous winter wheat crop, generally in July or August, ideally just prior to a rain event. “Then we harvest that wheat crop and the residue lays over top of the seed and,

hopefully, we get a rain event and some of those things start growing.” Winter-hardy species are chosen to improve chances for winter survival. Although he originally planted fall cover crops for their soil health benefits, he has also recently begun grazing these cover crops during the early spring. In 2017, he was able to graze them in the first half of April, at least a month and a half before spring-planted cover crops were ready to be grazed. Leitch is also intrigued by the possibility of planting a biennial, dual-purpose canola cultivar, grazing it during the first year, and then allowing it to grow and set seed during the second year. (For more information on this strategy in the Inland Pacific Northwest, see Kirby et al. 2017).

Benefits

Leitch has found that using cover crops makes his cow-calf operation more profitable. Instead of relying on grazing dried out pastures in hot summer months, he can supply his livestock with plentiful and nutritious summer food. Because of this, his cattle gain weight more quickly, and he has also been able to add more animals to his herd. “It changes the whole way that I look at my farm. Instead of just being a wheat farmer [who has a few cows], now I’m more of a rancher *and* a wheat farmer.”

Meanwhile, he also hopes this “cattle feed” is benefitting his soil health—and thereby his main wheat crop (Figure 8). Although he knows it will take time to see results, so far the impacts he has seen have been encouraging. For example, the cover crops have helped him identify and address previously unidentified soil compaction issues. Leitch explains, “The canola [roots] grew down five to six inches and then started to grow horizontally because the ground was compacted so much that it couldn’t get through. So that brought me a little bit closer to my soil as far as realizing what was going on underneath the ground. And since then, I’ve been trying to utilize canola and other crops with a deep taproot in the cover crop mix to help fracture any compacted soil.”

He has also seen small but noticeable improvements to crops that follow the cover crops. On one particularly poor piece of ground, several different neighbors commented on the improved quality of the wheat crop when it followed a cover crop. “They said the wheat just looks a lot better. Now as far as soil tests, there weren’t huge differences, but I know it looks better, and it was observed by more than one person.”



Figure 8. An important goal of Leitch’s cover cropping strategy is to improve soil health for winter wheat, his main crop—shown here in July 2015. Photo: Darrell Kilgore.

Challenges

The biggest challenge that Leitch anticipated—depletion of soil water by the cover crop—has not been an issue. On the contrary, Leitch has found that cover crops tend to help conserve soil moisture on his farm, likely by shading the soil and reducing wind exposure. “In the first year that University of Idaho had the cover crop trial [on my farm], they had some strips of chem [chemical] fallow that I sprayed out and left, and then the other strips had growing crops on them. What I found surprising was that when I went out and measured, I found that there was actually more water in the lush, green and growing crop than there was on the chem fallow.” (Note that soil water measurements were not taken as part of the University of Idaho study, but a new research effort on grazing cover crops in this region will examine its impact on soil water, as described in the sidebar *Landscapes in Transition*).

The other major concern Leitch anticipated was managing high amounts of cover crop residues. In a cropping system with no tillage—such as Drew uses—planting into residues can be challenging in this higher rainfall area where residues keep soils cool and damp, create unfavorable seeding conditions, and plug drills. However, Leitch has been able to manage these residues very similarly to how he manages wheat straw. Like many other growers in Lewis County, he uses a heavy harrow to fracture and reduce residue biomass prior to planting (Figure 9). After harrowing, he is able to plant into the residue fairly easily with a John Deere 1895 hoe-type drill that has a 5-inch paired row (12-inch row centers). “We run the harrow over the stubble one or two times to break it down...and we also utilize a roller harrow at times to help smooth the ground, seal any cracks or openings, and hold the moisture in.”

Like many farms, labor continues to be a challenge, especially at times of the year when his cropland operations require more intensive management. “It becomes a little bit taxing when I have lots of people out to help with harvest, yet we need to stop or get up an hour earlier and go move the fence or haul another load of water...although, generally speaking, it doesn’t take nearly as much labor as I thought it was going to.” However, he worries that this may become more of an issue if he continues to scale up and diversify his production.

Landscapes in Transition

Jodi Johnson-Maynard, Department of Soil and Water Systems, University of Idaho

Kendall Kahl, Department of Soil and Water Systems, University of Idaho

Karen Hills, Center for Sustaining Agriculture and Natural Resources, Washington State University

The Landscapes in Transition project, funded by the US Department of Agriculture National Institute of Food and Agriculture (USDA-NIFA), is focusing on the integration of two alternative crops (winter pea and cover crops with grazing/haying) into wheat-based rotations of the Inland Pacific Northwest region. The project, which runs from 2017 to 2021, has set up new replicated experimental plots in annual cropping (no fallow) and transition (fallow used but with crops generally grown more frequently than every other year) agroecological zones. In the drier crop-fallow zone, existing long-term plot studies are being utilized.

Project researchers from University of Idaho, Washington State University, Oregon State University, and United States Department of Agriculture–Agricultural Research Service are taking a systems-based approach to understanding the environmental and economic impacts of the diversification through these experiments. Baseline data on soil health, insects and soil dwelling organisms, weeds, disease, and profitability are being collected currently. These data will be utilized to improve the use of models and decision support tools to help growers make management decisions. Researchers are also working with farmers to fine-tune agronomic practices used to grow winter pea and cover crops.



Figure 9. The tines on the heavy harrow (closeup, left, and far view, right) run over the soil surface and break up wheat straw and other residues. Photos: Drew Leitch.

Managing Risk

So far, Leitch thinks that grazed cover cropping is helping to reduce long-term production risks by building more resilient, healthy soils. However, he worries that this practice also increases some types of production-related risks and uncertainties. For example, introducing new crop species could also introduce new problems to his farm—as has happened in the Pacific Northwest region with the

disease “black leg” which is a major pest to canola worldwide. (More information is provided in the sidebar *Risk of Black Leg in Cover Crops*.) However, he says his concerns are more about unknown or emerging risks than actual problems. Typically, if he knows about a specific risk he can avoid it. For example, he purchases certified disease-free seed to avoid “black leg.”

Looking Forward

Looking forward, commodity price drops are Leitch’s biggest concern, though he hopes that building the cow-calf operation and continuing to reduce costs where he can will help him survive the cycle of lower prices (see the sidebar *Costs and Benefits of Replacing an Annual Crop with a Cover Crop*). He also thinks that increasing the size of his cow-calf operation will reduce his economic risk by building a dimension of his operation that is on a different price cycle than wheat.

Over the longer term, the impacts from changing variability in weather, including drier summers, also concern him. Although he’s not sure of the causes, he notes that his area has received noticeably less snow in recent years. “When I was a kid, it was not

unheard of for us to receive snow in November and for it not to leave the ground until March. We haven't seen that during my kids' life, so it's been 18, 19 years since that happened." Together with the economic challenges, these factors make him worry that farming will be more challenging for his kids than it has been for him.

However, Leitch thinks that his cover crop and grazing system are a critical part of a broader strategy that will help his farm succeed whatever the future brings. He has been encouraged that a handful of other farmers in his area have begun to experiment with grazed cover cropping, and he hopes that they can work together to develop systems that maximize the benefits for profitability, soil health, and resilience.

Advice for Others

Leitch was asked what advice he would give to others who are thinking about grazed cover cropping within a dryland system in the Pacific Northwest.

Set a goal. "You need to know what you are trying to correct. What are you trying to do with cover cropping?" The goal will help define the acreage that should be targeted for cover cropping, the species used, and the timing within the rotation.

Start with soil testing. "You need to get a baseline." For Leitch, soil tests indicated that pH was an important problem. Although he doesn't expect cover cropping to raise soil pH, he wonders whether incorporating livestock will let him reduce his use of chemical fertilizers, helping to address the problem in a more sustainable way in the long run. "I've heard that in the Dakotas they cover crop and run the cattle hard enough on those grounds that they don't apply fertilizer. I'm not necessarily going to buy into that right off the bat, but one of my goals is to get more natural fertilizer applied to the ground by animals, and maybe over time I can apply less commercial fertilizer."

Risk of Black Leg in Cover Crops

Kurt Schroeder, Department of Plant Sciences, University of Idaho

Black leg of canola, caused by the fungi *Leptosphaeria maculans* and *L. biglobosa*, was only recognized as a disease in Idaho in 2011, when it was identified in Boundary County. Just a few years later, it was confirmed to be in a seed lot harvested from Nez Perce County. In the following years, the disease was found widespread across the canola producing area of northern Idaho (Latah, Nez Perce, Lewis, and Idaho Counties). Black leg is the most devastating disease of canola in Canada and other brassica producing regions around the world. However, the climate of the Inland Pacific Northwest is not considered to be particularly conducive for the disease due to the prevalence of hot, dry summer months. Late spring and summer rains are generally required for extensive spread of the disease, although fall and early spring rains may also cause some spread.

Symptoms of black leg appear as round or irregular shaped gray-white lesions on the leaves or stems that contain small black specks; these are the sporulating structures of the fungus. The pathogen can infect any above-ground part of the plant. Symptoms on canola versus cover crop species may vary somewhat, but the overall features will remain the same. Recent observation of black leg on a turnip in a cover crop mix on the Camas Prairie revealed classic symptomology of the disease (Figure 12).

Currently, black leg shows low potential to be a serious pest in Idaho. In 2016 and 2017, isolates of the black leg pathogen were found in 78% of canola fields surveyed, with the greatest incidence in winter canola. Despite the high frequency of fields confirmed with black leg, the extent of disease spread was usually low; disease severity on infected plants was quite minimal with little progression into the upper canopy of the plant. However, growers should be diligent in use of disease-free seed, treat seed with a fungicide, and scout fields for the presence of the disease, including fields with brassica species as cover crops.

When planning a cover crop mix, avoid using brassica species if black leg has occurred in a field during the past three years as the pathogen can survive in residue for many years. Likewise, do not plant a canola crop shortly following a cover crop in which black leg was confirmed. Tillage or harrowing to improve residue contact with soil and increase the rate of decomposition can help to reduce the longevity of the pathogen. For brassica species used in a cover crop mix, use certified disease-free seed from a reputable source and consider a fungicide seed treatment to limit the potential for introducing seedborne inoculum.

Several management strategies, such as foliar fungicides and planting resistant varieties, are impractical for cover crops. However, these are important disease control considerations for canola production if black leg has previously been observed or the presence of disease warrants fungicide application.



Figure 12. Black leg on turnip in a cover crop mix.
Photo: Doug Finkelburg.

Costs and Benefits of Replacing an Annual Crop with a Cover Crop

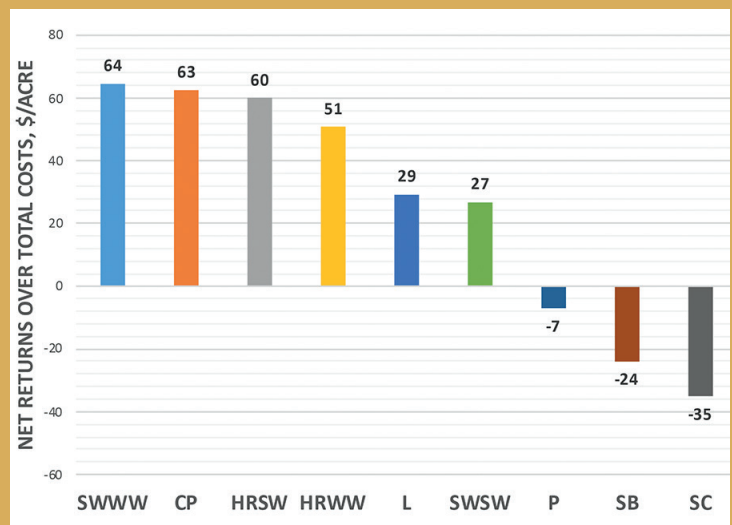
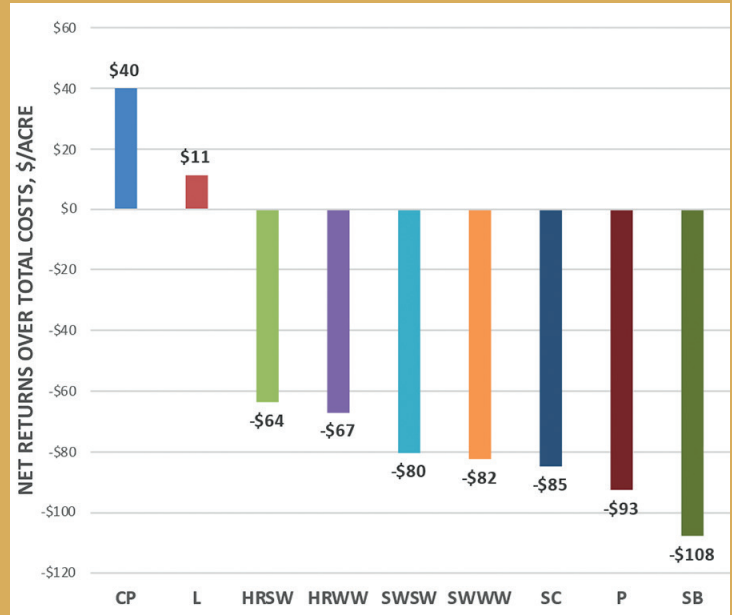
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Net returns for grain crops have been negative in recent years due to world-wide high production exceeding demand. Among the few profitable spring crops in this region in 2016 were chickpeas and lentils, at \$40 and \$11 per acre returns over total costs, respectively (Figure 13, upper; Painter 2017). During the previous five-year period, from 2011 to 2015, soft white winter wheat was the most profitable crop, averaging \$64 per acre, assuming an 80-bu per acre yield (Figure 13, lower). This is the dominant crop in the Inland Pacific Northwest dryland production region, grown on over 40 percent of all acreage in this region (USDA-NASS). Thus, the 2016 fall in profitability from \$64 per acre to -\$82 per acre has been a huge economic blow to the region's agricultural sector and rural economy. In 2017, grain prices rose slightly to \$4.78 per bushel (from \$4.26 per bushel in 2016, average price received for all wheat sold by PNW growers). However, these prices are still below the crop cost of production.

When traditional grain crops are unprofitable, returns from grazed cover cropping may be appealing, especially if cover cropping can deliver enhanced fertility, increased organic matter, and reduced erosion that benefits yields of future crops in the rotation. However, careful evaluation of cover cropping costs is still needed to support sound decision-making. Although costs vary quite widely between cattle production scenarios, Leitch's experience can provide a guide about the types of costs that may be relevant.

Seeding cover crops incurs some expenses, but they are much less than the typical costs of planting a spring crop. For example, a typical four-way cover crop mix of 20 pounds each of forage oats, forage barley, and spring peas, plus 2 pounds of canola seed, would cost about \$27.50 per acre. Field operations would include running a heavy harrow over the ground in



Key

CP	chickpeas	SB	spring barley
HRSW	hard red spring wheat	SC	spring canola
HRWW	hard red winter wheat	SWSW	soft white spring wheat
L	lentils	SWWW	soft white spring wheat
P	peas		

Figure 13. Net returns over total costs by crop, based on 2016 average farmgate crop prices (upper) and 2011–2015 average farmgate crop prices (lower). Reproduced from Painter 2017.

early spring, followed by a glyphosate application in late April or early May. The cover crops are seeded with a no-till drill in early May. For Leitch, total variable costs for these field activities, as well as the seed cost, were estimated at \$55.70 per acre. If added at seeding, fertilizer would be an additional cost, perhaps around \$20 to \$45 per acre, depending on the soil's initial fertility and the cover crop yield goal.

Revenue to offset these costs can come in the form of increased yield to the following crop as well as revenues from animal grazing, which may occur under a variety of scenarios, including purchasing and feeding cattle outright, renting pasture to others, or custom grazing animals that belong to others. At its simplest, the value of a cover crop produced for grazing cattle can be calculated based on typical pasture rent. The value of pasture is based on how many animals can be supported on the available forage, calculated as Animal Unit Months, or AUMs. Typical market value for northern Idaho is around \$20 to \$25 per AUM. Leitch calculates that one cow-calf pair per acre could be grazed for about four months during the summer. The cows' condition would be maintained, while a 200–300-pound calf would gain around 300 pounds during this period. Based on the market value, this pasture would support four AUMs per acre and could be rented for approximately \$80 to \$100 for the season. While this alternative is not highly profitable, costs are also low and are limited to those associated with the cover crop (described above). Estimates of profitability for grazing cover crops in the Midwest show modest returns at higher levels of yield potential, based on an AUM of \$22.50. A flexible calculator developed by Kansas State Extension allows producers to tailor income and expenses for their individual operation (Taylor et al. 2016).

Because he already owns cattle and has a ranch operation, Leitch has chosen to graze his own animals, a strategy that has higher investment costs, but also with the potential for higher returns. His experience suggests that he can graze three 600-pound calves per acre for 90 days on spring-planted cover crop with a gain of about 2 pounds per day. Over this period, the calves come up to an 800-pound selling weight by June or July. This would not be possible on grass pasture, which would have lost most of its nutritional value by early summer. Based on a conservative value of \$1 per pound of weight gain on a spring-planted cover crop, a 2-pound weight gain per day for 90 days would be worth \$180 per head. At a stocking rate of three calves per acre, the total value is approximately \$540 per acre. Operating expenses for the cattle operation, including transportation, providing water, and maintaining fences, would need to be subtracted.

A third scenario, with intermediate risks and returns, would be to custom graze calves. As in the first example, Leitch estimates three 600-pound calves per acre could be grazed, gaining about 180 pounds each over 90 days, for a total of 540 pounds of gain per acre. Leitch estimates that he could charge \$0.45 per pound for custom grazing, for a total of \$243 per acre.

In any of these scenarios, grazing cattle on ground that was previously used for annual crops will require some investment in fencing and watering systems. Drew calculates that his permanent fencing cost was about \$2,500 for a 50-acre field. However, this investment will last many years, so these costs would need to be amortized (spread out) accordingly. Portable cattle fencing used to divide the pasture into smaller paddocks for rotational grazing is relatively inexpensive and also lasts many years. Lastly, some provisions for watering will need to be made, either using trucks and tanks or some type of hose or mainline system.

Leitch's use of cover cropping has allowed him to expand his cattle herd from 45 cows to 150 head. Grazed cover cropping may continue to make sense in the near future, as the economic forecast for cattle production is more optimistic than for commodity crops, like wheat. While crop prices for most grains and oilseeds remain depressed (Figure 13) due to high production worldwide, demand for meat has risen to meet supply, resulting in strong meat prices in 2017. Demand for US meat is predicted to remain strong for the near future (FAPRI 2018). These two markets are relatively independent, which spreads market-based risk. Accordingly, investing in the health of your soil at times of market uncertainty or low profitability may be an excellent option for the long term.

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