Extension
University of Missouri

Grazing Cover Crops

Cover crop planting is becoming increasingly common in Missouri, practiced on 840,000 acres in 2017, more than double the acreage in 2012. While cover crops have been shown to pay for themselves through soil-health-related enhancements, such as input savings and modest yield boosts, there is a direct and easily tracked way of turning cover crops back into cash: grazing. With 11 million acres of row crops and close to 2 million grazing livestock animals (primarily cattle), Missouri might be better suited than any other state to capitalize on the grazing potential of cover crops. In addition to generating more income, grazing cover crops can have a positive impact on soil health. Manure, hoof action, and the root responses that grazing elicits stimulate soil biological activity and lead to healthier soil and healthier crops. This guide examines grazing cover crops from the perspectives of livestock owners and row crop farmers, and provides information on how to overcome some of the challenges that cover crops pose.

Soil health

Healthy soil does what we want it to do. For farmers and ranchers, this means supporting productive, healthy plants that are resistant to diseases, pests and drought. There are five principles of soil health according to the NRCS. Cover crops contribute to all five principles. Grazing cover allows for the fifth, livestock integration.

1. Soil armor
2. Minimizing soil disturbance
3. Plant diversity
4. Continual live plant/root
5. Livestock integration

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Figure 1. Missouri cattle graze on cereal rye in early spring. (Credit: Alan Weber)

Tackling cover crop grazing from each perspective

Livestock farmers

At the most basic level, livestock producers can think of cover crops as a vast source of underutilized, cheap forage. There are as many as 10 million acres of corn or soybeans in Missouri that could grow grazeable winter cover crops. Even one of the cheapest and most fool-proof winter cover crops, cereal rye, produces valuable forage. Cover crops should not be thought of as just cheap forage though; they can be very high quality. A study on grazing stockers on cereal rye in central Illinois found average daily gains between 2.04 and 2.85 pounds during when grazing at various times between October and April. Gains from a study in Missouri were more modest but still encouraging at 1.8 pounds per day for winter wheat and 1.6 pounds per day for cereal rye. The potential of grazing cover crops also lies in the fact that cover crops can provide forage during times of the year when perennial forages are scarce. Cover crops can be grazed at times of the year when perennial forages are less available and many producers are relying on expensive stored forage, leading to significant savings.

Row crop farmers

Row crop farmers may not think about cover crops as potential forage; they are more likely to be concerned with whether their effects on soil health and cash crop yields justify their cost. Cost of establishment is the biggest impediment to cover crop adoption. Economic returns from cover crops can take time to materialize and are often masked in the form of labor, fuel, herbicide, and fertilizer savings. Converting cover crop biomass into livestock sale revenue or rental payments is a much more direct and immediate way of paying for cover crop costs, turning cover crops into profitable short-term investments as well as long-term ones. However, there are other reasons for row crop farmers to consider bringing livestock onto their crop fields. Most of the additional benefits are essentially enhancements of what cover crops do on their own for soil health: livestock manure, hoof action, and grazing effects on plants stimulate soil biology, which improves nutrient recycling, water infiltration, and compaction relief. Finally, grazing cover crops gives farmers an extra source of income that can unlock the benefits of more diverse rotations that are otherwise unprofitable.

The practicalities

Before farmers can dive into what kind of grazing cover crops they want to plant and how many grazing days they can get from them, they must consider the necessary grazing infrastructure. For row crop farmers without livestock, fencing and water are usually the main deterrent to grazing their cover crops. Even for established livestock operators, the idea of setting up miles of fencing and establishing expensive watering systems is daunting. Luckily, we are living in an exciting time for grazing science. Improved fencing approaches (both for materials and rapid installation) and efficient watering technology is revolutionizing how farmers keep and move livestock. Moving livestock frequently does not necessarily mean more fence, time, or even high costs. High tensile electrified fencing has made perimeter fencing much more affordable and easier to maintain than old-fashioned barbwire. Temporary low-cost electric fencing with step-in posts, often using the assistance of an ATV or utility vehicle to quickly spool out or take up the electric polywire, is even cheaper and allows for quick and easy movement of livestock between paddocks. Some experienced livestock operators rely on single or double strand electric polywire for their perimeter fencing, further reducing the cost of grazing temporary pastures where cover crops may be planted. For livestock farmers that are still skeptical of the idea of using temporary electric fencing to manage livestock foraging on cover crops, remember that the alternative is usually hauling hay, a time- and fuel-consuming process. Many people grazing cover crops are surprised to find that they actually save time and fuel moving livestock using electric fencing versus bringing hay bales to livestock.

Water infrastructure has also benefited from technological advances. Portable water tanks are commonplace and make sense for cover crop scenarios. Those considering grazing only winter cover crops between corn and soybeans have an added advantage; livestock water requirements decrease during winter, and they can generally walk a longer distance to water than in the summer. If permanent water infrastructure needs to be built, NRCS conservation programs like EQIP can diffuse the cost significantly.

Compaction

Soil compaction is a common concern for farmers when considering whether to allow livestock on their crop fields. With the right management however, livestock are unlikely to cause compaction. Compaction from livestock is most likely to occur in the first 10 cm of the soil, and shallow hoof compaction has been shown to have no effect on corn and soybean yields. Grazing cover crops can actually decrease compaction compared to non-cover cropped fields in some cases, as was shown in case studies performed by Practical Farmers of Iowa. The lack of compaction at lower levels may be due to the manner in which grazing animals stimulate soil biology. Soil-dwelling organisms such as earthworms consume manure, and in the process, tunnel and channel through the soil. Plants that have been grazed also release exudates that, along with the activity of soil organisms, increase soil aggregation and therefore ameliorate or reduce soil compaction. These findings are hardly a guarantee that livestock cannot and will not cause compaction on crop fields. Poorly managed grazing may result in compaction even on perennial pastures, and they can certainly do the same on cover crops. Rotational grazing, proper stocking density, not overgrazing, and practices that deter loafing are still helpful for reducing injurious compaction. Critically, livestock should be removed from crop fields during excessively wet periods. There should always be a sacrifice lot, an area designated for muddy conditions ready for livestock when wet weather is imminent.

Getting the most out of your cover crop

There are two aspects of optimizing cover crops for grazing: selecting the right cover crop and managing it, both agronomically and through livestock. There are a lot of cover crop species and an overwhelming number of mixes to choose from. Although the choice of forage

matters, management decisions are very important, just as they are in perennial systems. A well-managed cover crop, even if it has a lower nutritive value potential, will probably outperform a poorly managed "perfect fit" cover crop when it comes to forage.

Management

Maximizing forage production

The most effective way of maximizing forage production from a cover crop is by extending the growing period. For most Missouri farmers in a corn/soybean rotation, this means planting cover crops as early in the fall as possible. There are a few strategies to do this. One of the more common methods is to fly on small-seeded cover crops in August. As corn and soybeans dry down, the canopy opens and allows through the light necessary for the cover crop to get started. When crops are harvested, the cover crop will take off and be ready for fall or winter grazing. The trick with aerial seeding is timing. Unless irrigation is available, a good rain is needed shortly after seeding for the cover crop to establish well. There are other ways to seed cover crops before crop harvest. High-boy sprayers can be adapted to broadcast seed between rows — also best done in August. Cover crops can be interseeded even earlier into corn with a conventional planter. This usually happens at the V6 stage, typically in June. The cover crop establishes before canopy closes and remains somewhat dormant until the canopy opens again in the fall. Even if farmers are unable to seed cover crops until after harvest, planting a cover crop with a drill in October or November could still produce a cover crop for spring grazing.

The other strategy for extending the growing season for cover crops is shortening the growing season of selected cash crops. By choosing earlier maturing varieties, cash crops can be planted later and/or harvested earlier, allowing more growing days for the cover crop. Whether doing so makes sense economically depends on a number of factors, but in some cases the extra forage growth gained from planting cover crops earlier may outweigh the yield reduction in the cash crop. Incorporating small grains into the rotation can be another way to allow more growing time for cover crops that will be grazed. Harvesting small grains such as winter wheat in June or July followed by a mix of warm-season cover crops can provide months of forage growth, and up to 10 months of cover crop growth if cool-season species are added to the mix.

Grazing management

Grazing management for cover crops differs from both perennial systems and summer annual pasture systems. One consideration is whether or not the cover crop will be grazed more than once (re-grazing). Warm-season cover crops, such as a mix of sorghum-sudan and cowpeas, have excellent potential to be re-grazed. Fall grazing of winter cover crops may be limited to a single time window, unless good regrowth of the cover occurs in the spring. If farmers want to re-graze a cover crop, they need to leave enough behind for the plant to recover. For winter cover crops, that typically means leaving at least 3 inches of growth. Winter cover crops like cereal rye and triticale can recover well and produce abundant forage in the spring, if enough was left behind after a winter grazing. The more vegetation is left after the first grazing, the faster growth will be in the spring.

There are many situations where cover crops are not intended for multiple grazing events. If the cover crop will be or has already been killed by cold temperatures, there is no point in managing for regrowth and more of the crop can be taken. Strip grazing, in which a day's worth of grazing is provided to livestock by moving temporary fencing a short distance each day, is a common grazing technique for cover crops that minimizes wasted forage. In cases in which cover crops will not be re-grazed, such as stockpiled sorghum or brassicas in late winter, a back fence is not necessary. A back fence should be used if they will be re-grazed to allow the forage to recover.

It is even possible to use grazing to assist in terminating a cover crop. High stock density grazing of reproductive cover crops can be a fairly effective way of terminating some cover crop species, although for other species some herbicide or other termination strategy may be needed. Even when grazing forage for one-time use, there is value in leaving some residue behind. Aboveground vegetation, even dead, helps protect the soil from erosion and temperature extremes. For growing cover crops, taking away too much vegetation will reduce the root mass and its multitude of soil health benefits.

Stocking rate (AUM/acre) and density (AU/acre) are important considerations when grazing cover crops, since over-grazing can be detrimental to plant growth

Grazing jargon

One "animal unit" (AU) is equal to 1,000 pounds of live weight, traditionally the average weight of a grazing cow. Thus, an animal unit equivalent (AUE) is the average weight of your animals divided by 1,000. The amount of forage it typically takes to sustain 1,000 pounds of animal for 30 days is an animal unit month (AUM). These units put all sizes and species of animals into a common unit of measurement, so it is easier to figure out what a given forage bank can reasonably sustain over a growing season.

and soil structure. Appropriate stocking rate and density can vary depending on many different factors including type and performance of cover crop, soil type, weather conditions, and the species and size of the livestock doing the grazing. Furthermore, a continuously grazed cover crop should be stocked and managed differently than a rotationally grazed field. Generally speaking, rotational grazing is recommended, as it leads to a higher forage utilization rate and less waste. Given that appropriate stocking rate and density are ultimately determined by how much forage is available and the length of time the animals will be grazing it, any environmental or management factors that can impact cover crop yield will influence how many animals your field can carry during its growth. Keeping in mind that annual cover crops should be grazed differently than rangeland and perennial pastures, consult with a grazing management specialist to help you determine what is most appropriate for your fields.

Cover crop selection

Cover crops can be divided into cool-season and warm-season species. This list is not exhaustive.

Cool-season cover crops that grow best in fall and/or spring

Grasses

Grass cover crops are common because of their low cost, ease of establishment in the fall and effectiveness at limiting erosion and scavenging nutrients. They can provide excellent forage and some have the potential to be grazed in the winter and the spring.

Cereal rye. Winter hardy, productive, and forgiving of late seeding even into early December, cereal rye is one of the most common cover crops. Fortunately, it makes for good forage. Cereal rye seeded in August or early September can produce enough forage for 30 or more grazing days in the winter, depending on stocking density. If not overgrazed, cereal rye can produce 3,000 pounds or more of high quality dry matter per acre in the spring. It grows faster in the spring than any of the other small grains, and thick stands of cereal rye make for good calving areas. Cereal rye rapidly loses nutritive value with maturity, and should be grazed by cattle before anthesis. Small ruminants can, and may prefer, to consume small grasses at or after anthesis, however.

Winter wheat. Winter wheat is a common cover crop, especially in southern parts of Missouri. It grows more slowly and produces less biomass than cereal rye or triticale, but is of slightly higher quality. Wheat maintains its forage quality longer than cereal rye.

Triticale. A hybrid between cereal rye and wheat, triticale is in many ways an intermediate between the two. Its best quality is that it holds its forage quality longer than either cereal rye or wheat.

Barley. Barley is the most palatable of the cool-season small-grains. It also produces a lot of fall and winter forage. However, it does not overwinter well in northern Missouri and produces less in the spring than other winter-hardy species.

Oats. Oats are similar to barley in terms of palatability and nutritive value. Oats usually winter kill, but make up for the lack of spring growth by growing quickly in the fall, usually producing more fall biomass than any other fall-planted cereal. The most commonly used oats for cover crops are spring oats. Other types are also available. Winter (Bob) oats can grow a little longer into the winter and may overwinter under mild conditions. Black oats are a different species of oats that has shown some promise for good fall growth, though more research is needed on best uses of this species.

Annual ryegrass. Ryegrass is a popular choice for grazing. It grows very rapidly in the spring and can be grazed repeatedly. Ryegrass is also one of the best grasses for June interseeding into corn, which allows for more grazing in the fall and winter.

Legumes

Clovers, peas, vetches, and medics all grow slowly in the fall but can provide excellent spring forage. Legumes add atmospheric nitrogen to the soil and can reduce the amount of nitrogen fertilizer needed for crops like corn and wheat. From a forage quality standpoint, there is little to separate them other than relative likelihood of causing bloat. There is important variability in their overwintering capabilities, however.

Crimson clover. A very palatable and high quality forage with moderate bloat risk. As a true winter annual, it gets off to a faster start than most other clovers in the fall, and quickly grows in the spring. It is one of the few legumes that matures fast enough to have the potential for nutritive value to start declining by mid-May, such as when soybeans would be planted.

Balansa clover. Cold hardy and heat tolerant, balansa clover is reliable and a good grazing option. Like crimson clover, it's a true winter annual. If the cover crop grows into June, balansa will retain its forage quality longer than other clovers because its stems remain hollow, not woody.

Berseem clover. A biennial clover that does not establish quite as quickly as crimson clover, but has reasonably good growth. It can regrow quickly after being grazed. It is fairly drought tolerant, but is not as cold hardy as some of the other legumes. It may not overwinter in most of Missouri, depending on variety.

White clover. A perennial that overwinters well and tolerates grazing well because of its low growth habits. Not as productive in terms of total biomass as others. High risk of bloat.

Red clover. A winter-hardy perennial familiar to many livestock owners. It has a low bloat potential.

Austrian winter pea. Has good fall growth if planted early enough (August or early September), but can be killed by a hard frost, especially if planted in October.

Hairy vetch. Among the most winter-hardy annual legumes. It produces abundant spring biomass, but can be toxic to cattle and horses if it makes up more than 10 percent of forage dry matter.

Brassicas

Brassicas, and in particular radishes, are popular cover crops because of their ability to reduce compaction. They also make excellent forage that produces a lot of biomass. Their carbon-to-nitrogen (C:N) ratio is very low, which makes them a bloating risk if grazed as a monocrop. However, when mixed with a grass, bloat is not an issue. For winter grazing, all brassicas need to be planted, at latest, in October. August and September seeding dates are ideal. Different species and varieties grow at different rates and put on differing amounts of top growth versus edible tubers. Some brassicas overwinter and can be grazed in the early spring. Livestock can be reluctant to eat brassicas at first. Once they are forced to eat them though, they acquire a taste for them.

Canola/rapeseed. Canola is an economical, reliable option for winter grazing. It grows quickly in the fall and overwinters well in most of Missouri, but not in northern states. Its leaves become more palatable after a frost. If fall grazed, it can be re-grazed in spring.

Kale. Kale is a good brassica for late winter grazing because it holds its nutritive value later than most cover crops. It typically winter kills in Missouri.

Radishes. With their vigorous fall growth and digestible tubers, radishes make one of the best winter grazing cover crops after corn or soybeans, when cover crop seeding can be quite late. They will not typically overwinter, which also makes them an attractive cover crop before corn for farmers who don't want to deal with terminating a cover crop. The radish tuber can be consumed as well, extending grazing opportunities after killing frosts.

Turnips. An often-overlooked brassica, turnips can provide similar-quality grazing as radishes while maintaining their nutritive quality longer after a killing frost. In some areas they will overwinter. Like radishes, their tubers make excellent fodder after frost.

Collards. Collards are a very palatable brassica with great potential to re-graze. It is cold-tolerant, and if planted in the spring, it will not bolt.

Seeding rates

Seeding rates might need to be adjusted when grazing cover crops. Seeding rates for small grain cover crops usually range between 20 to 50 pounds per acre. To gain more biomass for grazing, those rates should be increased by up to two times. Brassica, legume, and other broadleaf seeding rates typically should not be increased in order to gain more grazeable biomass. For mixes, seeding rates for individual species should be reduced from pure stand rates; relative reductions will depend on the desired forage composition.

Warm-season cover crops that grow best in summer and are killed by a light frost

Grasses

Sorghum-sudangrass (sudex). One of the most popular warm-season cover crops for a reason, sorghum-sudangrass produces abundant, high-value forage. It can be re-grazed and stockpiled as well. Prussic acid and nitrate accumulation are potential issues.

Sorghum. While similar to sorghum-sudangrass, sorghum does not have as much re-grazing potential. Some varieties will produce more forage than sudex hybrids. Like sorghum-sudangrass, sorghum can produce dangerous amounts of prussic acid and nitrates. Sorghum can be stockpiled and strip-grazed through the winter as well. Grain sorghum may be more useful for stockpiling.

Grazing corn. Corn varieties bred for grazing are some of the highest quality forages available. However, grazing corn has high nutrient requirements, does not tolerate drought as well as other warm-season grasses, and could lead to disease or pest problems when corn is already in the rotation as a cash crop. An additional benefit is that is does not pose a prussic acid risk, although it can accumulate nitrates.

Pearl millet. Pearl millet is high in protein and can be re-grazed. It does not stockpile well, however. Forage types of pearl millet get good summer growth, though a bit less than sorghum-sudangrass. Pearl millet is drought tolerant and has the advantage of not being a prussic acid risk.

Foxtail millet. Foxtail millet does not regrow after grazing and does not produce as much forage as pearl millet. Not normally recommended for grazing purposes as a monocrop, but can be used in a diverse mix for grazing.

Teff. Teff is a very soft, palatable grass that cattle like to graze, but it does not tolerate heavy grazing. It does

Table 1. Seeding rates for single-species stands of common cover crops. For comprehensive information on planting windows, use MCCC's tool.

	Seeding rate pounds/acre for single-species stands		Planting dates*
	Drilled	Broadcast	
Cool-season cover crops			
Cereal rye	70–90	100–120	August to mid-November
Winter oats	80–100	110–130	August to early October
Triticale	70–90	100–125	August to late October
Barley	70-100	100–125	August to early October
Annual ryegrass	15–20	20–30	August to early October
Crimson clover	12–15	20–30	August to early October
Balansa clover	5–6	6–8	August to early October
Winter peas	30–40	60–80	August to late September
Hairy vetch	15	20	August to early October
Radishes	5–10	8–12	August to mid-September
Warm-season cover crops			
Sorghum	15–25	30–40	Late May to mid-July
Sorghum-sudan grass	30–40	40–50	Late May to mid-July
Pearl millet	10–15	20–30	Late May to mid-July
Cowpeas	30–50	70–100	Late May to mid-July
Sunn hemp	15–25	40–60	Late May to mid-July

* Planting dates are calibrated for central Missouri. In northern Missouri, move fall dates one week earlier and spring dates one week later. In southern Missouri, move fall dates one week later and spring dates one week earlier

tolerate heat and drought well and is often used for hay instead of grazing. It is quite fast-growing.

Legumes

Cowpeas. Cowpeas are the old standby of warm-season legumes. Heat, drought, and pest resistant, cowpeas will provide good forage at a low cost. They can regrow after grazing if there is enough time before frost. A number of varieties of cowpeas are available, but the most common for cover crop use and grazing is Iron Clay cowpeas.

Sunn hemp. Sunn hemp is tall, fast growing, and excellent forage. This crop is a great option to include in summer mixes, especially if there is a short summer window. It can reach 6 feet tall in 60 days and will regrow if lightly grazed. It dies at the first sign of frost.

Mung beans. Similar to cowpeas, mung beans are a reliable summer forage. They are more drought tolerant than cowpeas and grow relatively fast but may not produce as much biomass as cowpeas.

Soybeans. Originally used as a forage, soybeans can still fill that role as a cover crop. They are similar to cowpeas and mung beans. If soybeans are in the rotation as a cash crop, disease and pests could be an issue. Forage types of soybeans that are taller than typical field soybeans are available.

Other broadleaves

There are a host of other plants that could be used as warm-season cover crops. The following are some of the common broadleaves used. For grazing purposes, these should be used in a mix, as they are not nearly as good forage as the grasses and legumes mentioned.

Sunflower. Sunflower produces abundant biomass in a short time period. Its forage value is fair.

Safflower. Safflower is very palatable until maturity. Some varieties have spines that become numerous and detrimental as it reaches maturity. Spineless varieties such as Baldy should be used for grazing.

Okra. Okra is used primarily as a good source of vitamins for livestock.

Buckwheat. Fast emerging and growing, buckwheat is of decent forage quality. Buckwheat can cause photosensitivity resulting in sunburns on livestock with light-colored coats. If included in a grazing mixture, make sure buckwheat makes up less than 30 percent of forage intake.

Toxins

Farmers should be aware of some of toxins that can be present in cover crops. Nitrates, prussic acid, and saponins (cause bloat) are the three most serious and common toxins present in some cover crop species under certain growing conditions. For all three, dilution is the best prevention. A diverse mix of forages with plants from different families is unlikely to cause problems. However, either by design or by chance, farmers may find themselves grazing a cover crop composed mainly of a single species that could be toxic.

Nitrates. Nitrates, in small amounts, are not toxic. At high levels, however, they can cause difficulty breathing, staggering and death. Nitrates can accumulate to dangerous levels in a number of plants; grasses like sorghum, sorghum-sudan, and corn, and brassicas are the most likely cover crops to cause problems. Animals can be conditioned to high nitrate levels, so nitrate poisoning is most likely when nitrate levels rise suddenly. This can happen after a drought-ending rain or after a frost — avoid grazing a cover crop for five days after either of these weather events. Nitrates tend to accumulate in the stems of grasses, therefore rotational or lighter grazing also reduces the risk of poisoning. If in doubt, have the plants tested for nitrate levels. Interestingly, animals grazing on cover crops appear to be able to tolerate nitrate levels much higher than the thresholds established for feed.

Prussic acid. Several plant families create a toxin called prussic acid during stressful conditions. Prussic acid can lead to a quick death for livestock that consume it at sufficient levels. Plants in the sorghum family, specifically sorghum and sorghum-sudangrass, are the worst culprits in cover crop situations. Prussic acid concentrations are highest in new leaf material and plants stressed from drought or frost. Wait until sorghum species are over 18 inches tall to graze and avoid grazing them during a drought or five days after a frost.

Saponins. Most farmers will be familiar with the dangers that high-quality legumes like alfalfa and white clover pose. All legumes contain some saponins, but some contain quantities that can cause bloat in livestock. The best prevention is dilution, by including a grass in with a legume cover crop, and moderating grazing exposure during high-risk situations (young and/or monoculture legume stands) Some feed additives such as ionophores can be offered as a supplement to help ruminants deal with "bloaty" forage.

Wheat bloat. Rapidly growing cereal grains can cause bloat in cattle in the spring. Some cattle are more susceptible than others, and should be removed from the forage for the rest of the early spring. Supplements such as monensin can help prevent wheat bloat, as does limiting intake through more intensive management.

Taking cover crops to the next level

The key to why cover crops have such potential for livestock operations is their ability to fill forage and nutritional gaps. Cover crops are also rapidly-growing plants, since most are annuals, whereas pasture and hayfields typically consist of slower-growing perennials. Most of Missouri is firmly in the fescue belt and forage shortages are fairly predictable. Fescue, a cool-season grass, exhibits the classic "summer slump," growing abundantly in April, May, and June, then going practically dormant until October, after which point it produces modestly for another two to three months. That leaves livestock with little forage from December to March and July to September. Most Missouri producers fill those gaps with hay, which is expensive and highly variable in nutritive value. Cover crops have the potential to reduce the amount of costly hay, and in some cases, make 365 days of grazing possible.

Making use of cover crop forage from December to April requires only modest adjustments from row crop farmers in order to maximize cover crop biomass in a corn and soybean rotation. However, using only winter annual cover crops still leaves a summer gap in forage production, unless other pastures are used during that period. The easiest solution is to add a small grain to the rotation and follow it with a warm-season cover crop. Warm-season cover crops generate abundant, high-quality forage and offer considerably more flexibility and reliability than squeezing in cool-season cover crops. Unfortunately, by themselves small grains are often not economical. Many farmers who do grow small grains try to make them pay by double-cropping soybeans, an unreliable practice that results in a soybean crop two out of three years in the rotation. Income from grazing animals can be the key to justifying the small grain, even out-earning corn and soybeans due to the high value of forage during the heat and drought of mid to late summer.

Grazing cover crops to their full potential inevitably leads to thinking about row crops and livestock as an integrated system. The result is often more a product than a sum of the various livestock and cropping benefits.

For example, adding a small grain to a corn and soybean rotation does not simply substitute a summer's worth of livestock revenue and hay savings for a commodity crop. Having that small grain also helps break pest cycles that accumulate after years of corn and soybean rotation and increases future yields. Adding a small grain to make a three-crop, livestock integrated system is only the first step. There are certainly longer rotations and multi-species systems that could take further advantage of grazing cover crops.

Economic examples

The economic returns of grazing cover crops depend on forage production, existing infrastructure, livestock prices, and stored forage prices, among others. Below are several examples of the economics of grazing cover crops.

Example A

A generalized model developed by Alan Weber calculated a hay replacement value of $49 in year 1, and increasing values in the following two years. The model makes the following assumptions:

- Cereal rye generates 1,500 pounds dry matter per acre
- 50 percent of rye biomass is lost from hoof action and selective grazing
- 750 pounds per acre of rye replaces 1,093 pounds per acre of hay when 78 percent of hay is utilized and hay is 88 percent dry weight
- Hay is valued at $80 per ton
- Additional savings of $5.50 per acre for reduced machinery, fuel, and labor costs from not hauling hay
- Portable electric fencing and water are available

Example B

Practical Farmers of Iowa conducted a study on the grazing economics of cover crops in 2015 and 2016 using three cow-calf operations. Cover crops were planted in August or September and grazed sometime between October and December, and again in March-April. Economic returns, with cost-share, were positive in all cases and ranged from $1.56 to $60.09 per acre.

Example C

A case study performed by Missouri NRCS's Lauren Cartwright found a loss of $10.93 per acre in the first year given infrastructure investments, followed by $109 per acre profits in following years.

Although some of the examples above show negative returns without cost-share, at least the first year, they still represent savings on the cost of cover crops without grazing. If farmers are committed to cover crops regardless of whether they graze them or not, adding livestock to the equation will most likely save them money.

Examples in common rotations

Corn and soybean rotations

- Corn followed by a mix of cereal rye, radish and crimson clover
- Soybeans followed by oats and radishes

Farmers in a corn-soybean rotation are limited to winter cover crops, but these can still provide valuable forage. A solid cover crop choice after corn for grazing would include an overwintering small grain, a forage brassica, and a small-seeded winter-hardy legume. Some good options would be cereal rye, forage radish, and a berseem clover. If aerially seeded in August or September, there should be sufficient growth of the radishes and small grain for grazing in December or January. As long as it was not grazed too close (leave about 4 inches of grass), the small grain and legume should regrow in the spring and offer one to two more grazing opportunities until soybeans are planted. After soybeans, a mix of a fast-growing winter cereal like oats and a fast-developing brassica would allow for winter grazing. Oats and radishes winter-kill, meaning there would be no spring grazing, but there would little chance of that anyways with corn being planted in April.

Corn, soybean and wheat or corn, wheat and soybean rotations

- Corn followed by a mix of cereal rye, radish and crimson clover
- Soybean followed by winter wheat
- Winter wheat followed by a diverse mix (e.g., sorghum-sudangrass, cowpea, turnips, oats, etc.)

Wheat can be added into corn and soybean rotations after either crop, providing excellent summer and fall grazing. In Missouri, wheat after corn is more common than wheat after soybeans because there is more time for wheat to establish, but using wheat after soybeans can work and offers some different grazing opportunities. In a corn/wheat/soybean rotation, there is a long, almost 10-month cover crop growing period between wheat harvest and soybean planting. A diverse mix of warm-season cover crops can be drilled after wheat harvest. There are many good options to include in the mix, including grasses like sorghum-sudangrass, legumes like cowpeas, and broadleaves such as sunflower and okra. With such a long period before soybeans the next spring,

it is probably worth including cool-season cover crops in the mix. They will take off after the warm-season covers are grazed off in the fall and can provide grazing in the winter and spring before soybean planting. The cool-season component of the mix will have a better chance if the mix is not dominated too much by shady, competitive plants like sorghum-sudangrass and corn. Cover crops between soybean and corn would be as described above, with oats and radishes being a good option.

Wheat after soybeans offers slightly different grazing and cover crop options. As above, a warm-season mix can be planted after wheat harvest. Some farmers may prefer to use only winter-kill species to simplify corn planting in the spring. In that case, using a sorghum or sudex-heavy mix would provide stockpiled forage that could be strip-grazed in the winter. After corn and before soybeans, a cover crop of cereal rye, radishes, and a small seeded legume like crimson clover is a good option for winter and spring grazing. It can be grazed once in the winter and again in the spring before soybean planting. Wheat is planted after soybeans and harvested the following July. Immediately after harvest, a mix of cover crops should be drilled in. There are a huge number of options for the warm-season covers. Most mixes include sorghum sudangrass. The mix can contain a legume like cowpeas and a variety of broadleaves like sunflower and okra. It is also a good idea to include some cool-season species in the mix. Oats and turnips will emerge and grow slowly under the canopy of the rest of the mix. When the warm-season plants are grazed off in late summer and early fall, the oats and turnips will take off and supply quality grazing for the winter. Assuming the cool-season species winter-kill, there will be no spring grazing, but easy planting conditions for corn.

Rice/soybean

- Rice followed by black oats, radish, and Austrian winter pea
- Soybean followed by cereal rye, berseem clover, kale

Cover cropping on rice fields has received less attention in Missouri, partly because of some of the difficulties involved in cover cropping after rice and partly because many rice farmers flood their fields during the fall and winter. That said, planting a forage crop after rice has been a common practice for years. Cover crops in a rice/soybean rotation can mimic those in a corn/soybean rotation. The high moisture common on rice fields in Missouri limits some of the species choices, however. Tillage radish, black oats, and Austrian winter pea are examples cover crops that work on rice fields; all would serve as good forage for livestock.

Renting and leasing cover crops for grazing

Becoming an integrated livestock/row crop farmer is simply not an option for some farmers. Both operations require investments in infrastructure, equipment, and time. Renting cover crop acres is an easy solution that benefits both types of farmers. Lease agreements for cover crops are similar to perennial pasture. The same types of leases can be used including:

1. Fee per acre
2. Performance basis (fee per pound of gain)
3. Animal unit month (AUM) method (the most common)

Cover crop pasture rent using the AUM method is calculated with a simple formula with three variables.

Pasture rent per AUM = A × B × C

A = market price per ton of hay

B = pasture quality factor — these can usually be obtained from Extension services. About 0.2 is fairly typical for a lush cover crop, although it could be higher.

C = Animal unit equivalent. There are standard values for various livestock at various life stages.

Output = Pasture rent per animal unit month. This can be divided by 30 to get the rent per day. Further information: Determining Pasture Rental Rates (https://www.ag.ndsu.edu/publications/livestock/determining-pasture-rental-rates#section-13).

Like renting pasture, the agreement should be clear about who is responsible for water, checking/repairing fencing, and who is liable for livestock losses. Cover crop leases have their own peculiarities, however. One of them is deciding who pays for cover crop establishment. Furthermore, the lease agreement should include the conditions under which livestock will be removed from the field. This might be a predetermined cover crop height or a date. It could also include severe weather situations or wet periods.

Harvesting cover crops for stored forage

Once people recognize the value of cover crops for grazing, it may be tempting to take it one step further and think of them as just another annual forage crop to be harvested. Harvesting cover crops for hay, baleage or silage is possible and can be profitable if equipment costs can be kept down. However, doing so comes at the cost of many of the soil health benefits that cover crops provide. Taking the aboveground biomass off the field

removes nutrients for the next crop, carbon from the soil ecosystem, and protective ground cover.

Summary

Livestock and row crops used to be integrated on almost every farm. It should not be a surprise that there are still benefits to doing so today. Cover crops allow for livestock integration in modern cropping systems, with the potential to add profit in the form of hay or row crop input savings. Whether by adding livestock oneself, or cooperating with neighbors to bring them onto cover cropped fields, grazing cover crops is worth considering. If new to cover cropping, there are numerous valuable resources available from MU Extension to help choose the right cover crop and management strategy listed at bottom of this page.

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