University of Idaho Extension

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Cover Crops for Grazing Use in Idaho

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Introduction

COVER CROPS PLAY AN IMPORTANT ROLE in combating many agricultural issues. While they are traditionally used as a soil-amending tool, they can also provide temporary pasture and high-quality feed for livestock. A cover crop is defined as any plant grown to provide living ground cover that is planted with or in between rotations of the primary or cash crop. Growing cover crops is considered a best management practice because research shows that cover crops help minimize soil erosion, prevent nutrient leaching, provide organic nitrogen for subsequent cash crops, improve soil tilth, suppress weeds, increase crop diversity, and provide beneficial-insect habitats.

Dual-purpose cover crops provide an economic advantage through grazing before, or in addition to, using the crops for other agronomic benefits. The most economical way to use dual-purpose cover crops is to plant following an early summer harvest and graze in the fall and spring, if planting a winter-hardy species. Cover crops can also be planted as a full-season forage crop. A full-season temporary pasture of cover crops is most economical when grazed multiple times in the summer and fall, but some species can also be harvested for storage or sale as feed.

In addition to their agronomic benefits, cover crops can help mitigate or increase agriculture's resilience to the effects of climatic change. Consistent years of severe drought in parts of the United States have encouraged producers and industry experts to use cover crops as low-input emergency forage. Research has also shown that cover crops can help hold spring and fall soil moisture from evaporation. In addition to drought, newly timed intensive seasonal rains are promoting disease activity in Idaho, and plant pathologists are recommending the use of cover crops as a crop rotation to help break disease cycles. Lastly, cover crops are promoted on the national level to reduce non-point source pollution.

This publication will help crop and livestock producers in Idaho or other high-desert systems select, plant, and manage cover crop species and mixtures that can also serve as livestock forage.

Considerations in Selecting a Dual-Purpose Cover Crop

Selecting which cover crop species to plant depends on cropping system needs, forage requirements, and how the grower wants to manage the land and cover crops. In addition, cover crop species differ in such characteristics as growth rate, seasonal availability, nutrient profiles, and how well they perform in a mix with other species. The growing characteristics determine when each species is at the optimal nutrient stage for grazing.

Cover crop species are divided into three groups—cereal grains and grass, legumes (or nitrogen-fixing), and brassicas—each of which will be discussed in

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this publication. The species listed here were selected based on cold hardiness, forage quality, forage yield potential, and suitability for Idaho growing conditions. Consider the characteristics of each as you choose which species best meet your needs.

Multi-species mixes

Planting a mix of two to five cover crop species is recommended to achieve multiple agronomic benefits. A multi-species mix can be comprised of any combination of cereals, legumes, and/or brassicas. One highly recommended mix for Idaho producers is a blend of triticale, arvika pea or Austrian winter pea, radish, and turnip. The triticale seed is easy to source and will reduce seed costs, arvika pea or Austrian winter pea provide excellent yields and forage quality, and a radish or turnip will capture soil nutrients, provide highly palatable feed, and improve soil quality and water-holding capacity. When creating a mix, producers should consider the different growth characteristics of each species, including germination timing and growth rate. The growth characteristics will determine which species will out-compete others and help dictate seeding rate adjustments if a balanced mix is the goal.

Growth time

In addition to considering agronomic benefits, producers should select cover crops based on the amount of time the plant can be in the field. For example, cover crops will flourish if they have 8 to 10 weeks of growth. However, establishing plants after late-harvested crops such as silage corn, beans, beets, or potatoes is a significant challenge in Idaho. The growth time is too short to contribute any sizable forage production before the cover crop freezes. If a crop can stay in the field for a full growing season, all species listed in this publication will provide adequate yields. However, if growth time is limited, producers should select a winter-hardy perennial mix or a fast growing fall annual mix. Consider the amount of time required for a sufficient yield, especially with perennial legumes, which are slower to establish and would be the most expensive seed in your mix.

Species selection will also depend on whether you want spring regrowth or complete winter-kill of the plants. If you want spring forage production, keep in mind that the crop will need 3 to 5 weeks after winter to yield enough growth. For example, if you follow a winter cover crop with early planted crops such as spring grain or beets, this will most likely not allow enough spring regrowth to provide forage in most areas of Idaho. Depending on the location, a cover crop that survives the winter might or might not require additional residue management before the spring crop can be planted. Spring plant material can be managed with herbicides, tillage, or, in some cases, no management with the use of a no-till drill.

Water and planting methods

After seed selection, the next major considerations for a healthy cover crop stand are water and planting methods. Irrigation or timely rain will promote best establishment. Consider the water needs carefully, as cover crops must be treated like any other crop. For example, small seeds such as radish or turnips are planted at shallow depths and will dry out quickly in the hot summer sun. Depending on equipment availability, a producer can plant cover crops using conventional drills, with or without pre-tillage, or no-till drills. Some soil conservation districts in Idaho have no-till drills for rent, or custom operators will no-till drill for a fee.

Weedy cover crops and green bridges

Producers are often wary of cover crops becoming a weed problem. Hairy vetch, ryegrass, buckwheat, and others can become problematic if not managed properly. Grazing, cutting, or tilling prior to seeding will prevent these cover crops from becoming weeds. If cereal grains are part of the farming operation, the use of ryegrass (not cereal rye) is not recommended.

In addition to potential weed problems, producers should note the risks of a potential “green bridge” when replacing a traditionally winter-fallow system with green cover crops. The term green bridge refers to living green plant material acting as a host for pathogens or pests during winter or fallow periods. Traditionally, a green bridge consists of crop volunteers—usually from the previous year’s crop, and sometimes from crops grown one or two years before. By acting as a host, a green bridge can trigger epidemics of insects and diseases in the growing season, which can be difficult to control. The potential for a green bridge should be evaluated on an individual site basis.

Volunteer grains as cover crops

For the producer who is just looking for winter grazing and some soil cover, the most economical practice is to simply water-up volunteer wheat or barely. Measurements by University of Idaho Extension have indicated that volunteer barley can yield as much as mixed-species cover crops for forage use. When using this method, growers should spread the chaff row to distribute the grain seed as much as possible. If left in a single chaff row, the grain will compete with itself and leave much of the field surface open for weeds. Also, some cattle may not want to grub down into standing grain stubble. Swathing or shredding the stubble to a shorter height will help with this issue. Note that with a late July or early August harvest date and a long fall, it's possible for volunteer grain to begin to head out. To achieve maximum quality from cereal forages, be sure to graze or harvest prior to or right at boot stage.

Cereal Grains and Grasses

Cereal grains and grasses are suitable as dual-purpose cover crops because they contribute organic matter to the soil, reduce seed costs in a cover crop mix, and increase forage yield when planted with a legume. When planted with a legume, cereal and grass species will reduce the forage quality but increase the amount of feed available. If planted following a cereal crop, a cereal is not necessarily needed in the mix unless spring regrowth is desired.

The extensive root systems of grains and grasses can scavenge soil nutrients in the fall and help recycle the captured nutrients through decomposition in the spring. This same nutrient scavenging ability can also mean that some grasses may accumulate high concentrations of nitrates, which can lead to nitrate poisoning. This risk is discussed in greater detail later in the guide.

Pearl millet

Pearl millet is a warm-season annual grass commonly grown as an emergency forage with a high nutrient value (figure 1). As a nutrient-rich grass, pearl millet is high in energy and protein and low in fiber and lignin concentrations. Pearl millet is most suitable for young cattle, lactating dairy cows, or calves under management intensive grazing that can utilize the feed efficiently. The feed is considered too costly to use for mature animals or those with low nutrient needs.

Figure 1. Top: Mid-June-planted pearl millet in August. Bottom: Mid-August-planted pearl millet in October with some frost kill, Kimberly, Idaho. Photos by Christi Falen.

There are two types of pearl millet: tall or dwarf varieties. Dwarf varieties produce leafier forage and will provide a higher average daily gain than taller varieties. The tall-growing pearl millet can be grazed or harvested for hay or silage. If grazing, University of Georgia research suggests that animals should graze dwarf pearl millet when the plants reach 18 to 20 inches in height. If it is a full-season planting and you want regrowth for a fall grazing period, remove animals when stubble height is 6 to 8 inches. Some evidence suggests that using a higher seeding rate with pearl millet will produce a higher leaf:stem ratio, improving forage quality.

This grass has an extensive root system, making pearl millet a drought-tolerant species that does better than others under low-moisture conditions. Pearl millet is most suitable for well-drained sandy or light loam soils.

Unlike sorghums, pearl millet will not tolerate flooding or water logged soils. This grass doesn't yield as much as other warm-season annuals (such as sorghum-Sudangrass) but is a safer feed source during the growing season because it does not contain prussic acid, which under certain conditions can lead to prussic acid poisoning (discussed in detail below). However, pearl millet's root system allows the grass to scavenge nitrogen from the soil profile, which can lead to high nitrate levels. Pearl millet will die in the winter and works well when planted alone or as a selected grass in a mix of legumes and/or brassicas.

Sudangrass and sorghum-Sudangrass hybrids

Sudangrass and sorghum-Sudangrass hybrids (figure 2) are warm-season annual forages commonly used to scavenge residual soil nitrogen, suppress weeds, suppress certain diseases and nematodes, and improve soil quality. These grasses survive on a variety of soil types and under low-moisture conditions. They grow rapidly and produce significant tonnage; they also add carbon, or organic matter, to the soil in the long term but can tie up plant-available nitrogen in the short term.

Certain cover crop species have a greater risk of accumulating high levels of nitrates and prussic acid. Prussic acid poisoning, also known as cyanide poisoning, can be a particular concern with sorghums. Among the species listed in this publication, sorghum has the highest levels of prussic acid and sorghum-Sudangrass hybrids have intermediate levels.

Cyanogenic compounds are located in the plant's outer tissue (epidermal cells), while the enzymes that enable prussic acid production are located in the leaf tissue (mesophyll cells). Any event that causes the plant cell to rupture—allowing the cyanogenic compound and the enzyme to combine—will produce prussic acid. Plant cells can be ruptured by cutting, wilting, freezing, drought, crushing, trampling, chewing, or chopping. Therefore, any stress to the sorghum plant can potentially release hydrogen cyanide compounds, which can quickly be absorbed in the bloodstream when ingested. Livestock with prussic acid poisoning can show symptoms within 5 minutes, and may die within 15 minutes of eating plants. Do not graze Sudangrass and sorghum-Sudangrass hybrids for 2 to 3 weeks after a frost. Prussic acid will dissipate, so the material can be grazed once a forage test indicates safe feeding levels.

Leaf blades contain higher levels of prussic acid than leaf sheaths or stems, so producers should wait to graze any cover crops in the sorghum family until they are 2 to 3 feet tall.

All sorghum species should be closely monitored during times of environmental stress for nitrates and prussic acid. Nitrate poisoning will be discussed in detail further on.

The sorghum-Sudangrass hybrids Special Effort, Enorma, HayKing, Forage King, Cadan, and Nutri-Plus have all performed well under Idaho growing conditions. Sudangrass and sorghum-Sudangrass hybrids work well planted alone or as the selected grass species in a mix of perennial legumes and/or brassicas. Sudangrass and sorghum-Sudangrass hybrids will winter-kill.

Figure 2. Sudangrass and sorghum-Sudangrass hybrids grow rapidly and produce high yields. Photo by Christi Falen.

Triticale

Triticale (figure 3) is an annual cereal crop that consistently produces good yields in a relatively short period of time. Triticale is a cross between wheat and rye, with the grain quality, high yields, and disease resistance of wheat and the hardiness of rye. Triticale works well on a variety of soil types and in a variety of cropping systems. This crop can grow under irrigated or limited-irrigation conditions and is considered a low-input crop.

As a forage, triticale is high in energy, moderate in protein, and high in sugar, with good digestibility. Triticale's amino acid composition is similar to the protein in wheat but slightly higher in lysine. The lysine content in triticale is typically higher than corn. At the soft dough stage, triticale's available energy is similar to that of corn silage but with more effective dietary fiber. Producers should buy an awnless or semi-awnless variety for use as forage. Idaho producers commonly select triticale as the grass species in a larger cover crop mix because it improves yields and reduces seed costs. In a legume and triticale mix, the triticale will increase the yield while the legume will boost protein content.

Figure 3. Triticale has the quality and yields of wheat and the hardiness of rye. Photo by Lauren Golden.

Barley and wheat

Barley and wheat varieties are high-yielding annual cereal crops. When used as cover crops, they provide soil coverage and decrease sunlight to the soil, which discourages weeds from establishing. Barley and wheat also improve soil tilth and scavenge nitrogen from the soil profile. These cereal grains are an excellent alternative to traditional hay crops because they are drought resistant and provide good yields and valuable grazing opportunities. Barley and wheat varieties can grow under irrigated or dryland conditions. Wheat yields are usually higher than barley and wheat can tolerate poorly drained, heavier soils better than barley.

Barley matures early, making it beneficial for early grazing with sufficient time for regrowth, while wheat is slower to mature, making it suitable in a mix with slow-growing legumes. For example, Willow Creek winter wheat (figure 4) is an awnless variety that matures later than triticale or barley, making it a successful cereal in a slow-maturing legume mix. Winter varieties of barley and wheat should survive the winter and are appropriate for a fall planting. Awnless varieties of both species are preferable for livestock forage.

Producers should consult fertilizer guides for each species because insufficient nitrogen can decrease yields but excess nitrogen combined with low water availability can result in unsafe accumulated nitrate levels. Barley and wheat varieties can either be mixed in a fall planting, a spring planting, or a full-season cover crop mix. Cereal grains are recommended for use in a larger mix of legumes and/or brassicas because the grass helps provide structural support for the viney legumes.

Figure 4. Willow Creek winter wheat (right) matures later than some cereal grains, making it a good crop to mix with a slow-maturing legume. Photo by Christi Falen.

Legumes

As a dual-purpose cover crop, legumes are important because they provide a source of organic nitrogen for the soil as well as high-protein feed. Legumes fix atmospheric nitrogen with symbiotic root rhizobia (bacteria), and accumulate nitrogen as protein in the above-ground forage. The nitrogen in the plant tissue can be used for both high quality feed and as a source of organic soil nitrogen through plant and soil incorporation.

In Idaho, increasing pest problems are encouraging producers to plant cover crops such as winter-hardy legumes during fallow periods. Research in Australia has found that the rotation of an annual grass-free legume pasture can effectively control cereal cyst nematodes and other cereal diseases. A 2- to 3-year rotation is optimal for best control, although one winter of rotation has the potential to break pest and disease cycles.

Due to a higher seed cost, it's beneficial to plant legumes in a mix, which will reduce the forage quality but increase the forage yield. Note that when purchasing legumes, ask seed dealers for the appropriate inoculant for your legume. Legumes must be inoculated with the proper bacteria to stimulate their nitrogen benefits.

Arvika pea

Arvika pea is an annual legume planted for its high yields and forage quality (figure 5). The pea grows rapidly, providing excellent weed control and high yields. Arvika peas will not survive the winter, unlike Austrian winter peas or hairy vetch, and is therefore recommended for organic producers or those in the early stages of cover crop adoption. Winter-kill makes this pea easy to manage for new cover crop users and easy to use without chemical control for organic producers. The pea will provide dead residue in the spring, which helps control spring weeds. However, the seeds can be difficult to source.

Arvika pea is commonly used in perennial grass mixes to increase the yield, improve forage quality, and provide a great source of early feed before perennials in the mix are available. The large leaves provide excellent palatability for livestock. It is recommended that arvika peas be mixed in a grass cover crop mix, providing high yields and high quality animal feed.

Austrian winter pea

Austrian winter peas (figure 6) are a favorable annual cover crop for Idaho producers because the pea consistently performs well under a variety of growing conditions and is easy to source. Austrian winter peas are good dual-purpose cover crops because the pea provides high yields, excellent nitrogen contribution, and high forage value. Austrian winter peas will survive the winter, providing grazing in the fall and spring. It's best to graze Austrian winter peas before the first frost, leaving 3 inches for regrowth; extra growth left in the fall is more susceptible to frost damage.

The steady performance of Austrian winter peas in Idaho makes it an excellent legume for a cover crop mix. In three cover crop trials in Idaho, Austrian winter

Figure 5. Rapid-growing arvika pea is known for its high yields and forage quality. Photo by Lauren Golden.

Figure 6. Austrian winter peas are winter-hardy and performed well in Idaho cover crop trials. Photo by Christi Falen.

peas provided the highest forage value and the highest or second highest yield on individual sites, compared to hairy vetch, chickling vetch, and arvika pea. Austrian winter peas yield best when planted with a grass species, such as triticale. Alternatively, producers can plant 100 percent Austrian winter peas for a lower yield but higher forage value. Some Idaho producers have planted a full-season crop of Austrian winter peas for both a summer and late-season grazing period, and some have cut and harvested Austrian winter peas for stored feed.

Chickling vetch

Chickling vetch (figure 7) is a slow-growing, annual creeping vine that is best suited for a full season of growth in Idaho. Chickling vetch can perform well under dryland or limited irrigation conditions; the plant will exhibit leaf curl to conserve moisture in dry conditions. This low-growing annual pea can be used as an understory crop or a relay crop, planted between rows of a spring-seeded cereal or vegetable system. In Idaho, cover crops are promoted to prevent topsoil loss from wind erosion. This viney legume can be used on summer sites where wind erosion is a problem; however, chickling vetch will not survive the winter.

Chickling vetch needs at least 60 days of growth for high nitrogen fixation and decent yields; therefore this legume is not suitable for a short growing window. Under a full season of growth, producers can expect good yields and excellent forage quality. For example, in a high-elevation full-season trial (118 days) in Idaho, chickling vetch yielded 5.5 tons per acre of dry matter, yielding more than Austrian winter pea and hairy vetch. In a shorter growing window, chickling vetch produced only 2.5 tons per acre of dry matter in 93 days of fall growth.

Figure 7. Chickling vetch performs best with a full season of growth. Photo by Lauren Golden.

Cicer milkvetch

Cicer milkvetch is a perennial legume commonly used in the intermountain west for grazing, hay, and soil conservation. In acidic, alkaline, and low fertility soils, cicer milkvetch will survive better than alfalfa. Cicer milkvetch requires a higher soil temperature to germinate and is therefore typically slower to establish in Idaho compared to other species. This slow establishment also limits the ability of cicer milkvetch to provide good weed control. Therefore, this species is best used as a long-term cover crop or in a pasture mix of fewer than five species.

Cicer milkvetch spreads through rhizomes, allowing the species to resist overgrazing; close grazing actually stimulates growth of the lower leaves, crowns, and rhizome buds to promote rapid recovery. Because of its rhizomatous root system, cicer milkvetch is good for erosion control and for revegetating disturbed areas at higher elevations. The showy flowers are good for home garden use and for attracting beneficial insects. To attract pollinating and beneficial insects, plant cicer milkvetch under locations where the pivot end gun is turned off or in vegetative pollinating strips.

Cicer milkvetch will perform best on fields receiving 18 to 35 inches of moisture annually, but the species will survive under dryland conditions in Idaho and Montana. However, under irrigated research trials in Idaho, cicer milkvetch had lower yields compared to other cover crop species. It is not recommended for use in a multi-species mix because the other species will provide too much competition for the milkvetch seedlings.

Clovers

Clovers are commonly planted in a pasture mix because they improve forage quality, contribute nitrogen to the soil, provide soil stabilization, and perform well under low-moisture conditions. Producers can select either annual or perennial clovers to plant as a dual-purpose cover crop. However, clovers are an expensive, low-yielding crop if planted for only one season. If you're looking to plant a cover crop for one season, consider another annual legume listed in this publication, such as arvika pea. Growers can

use perennial clovers in a perennial cover crop mix, but should expect slow establishment of the clovers compared to other species in the mix. Producers can help mitigate this by increasing the seeding rate of clovers and decreasing seeding rates of other species in the mix, especially grasses and brassicas.

Hairy vetch

Hairy vetch (figure 8) is a vine-like, vigorous annual cover crop that behaves like a perennial. It is widely planted as a cover crop because it accumulates the highest levels of nitrogen. Hairy vetch is drought-tolerant and can survive on a variety of soil types and under marginal field conditions. The vetch is commonly grown in pastures, withstanding trampling and providing early summer feed when planted in spring. Harvesting hairy vetch requires special equipment.

In Idaho, the perennial-like growth of hairy vetch makes it slow to establish in a fall cover crop mix of five or more species. Producers can expect better yields when it is planted alone or in a smaller mix as a full-season crop, or as an early fall planting that allows for at least 50 days of growth. Hairy vetch will yield most when planted with one other grass species. Producers may also choose to plant 100 percent hairy vetch for a lower yield but higher forage quality.

Figure 8. Hairy vetch is hardy and holds the highest levels of nitrogen among cover crops. Photo by Lauren Golden.

In a fall planting with 68 days of growth, a hairy vetch/triticale mix yielded the highest with 4.5 tons per acre of dry matter in Idaho compared to Austrian winter pea/triticale mix and 100 percent Austrian winter pea. In Kimberly, Idaho, a fall planting of hairy vetch/triticale provided a dry-matter yield of 3.6 tons per acre in April, which allows enough time for a spring grazing period followed by a cash crop planting. Idaho cover crop soil research found that hairy vetch provided the most soil nitrogen in the spring following a fall planting compared to Austrian winter peas and arvika peas. In these same trials, hairy vetch had good forage value but Austrian winter peas consistently provided a higher forage quality.

Although hairy vetch performs well, it's not highly recommended for Idaho producers because its persistent nature makes it difficult to kill with tillage alone, potentially creating weed problems. However, under certain circumstances, research shows that hairy vetch can provide very high yields, excellent forage value, and soil nitrogen benefits.

Brassicas

Brassicas are a genus of plants in the mustard family. Optimal brassica species for high-desert farming systems include mustards, canola/rapeseed, radish, and turnips. Brassicas are good cover crops because they provide a variety of agricultural services. Brassicas germinate and grow quickly, helping to out-compete weeds. Most brassica species have long taproots and/or horizontal roots that help to scavenge nutrients deep in the soil profile, preventing soil nutrients from leaching below the plant root zone. The taproot also penetrates deep into the soil, helping to mitigate soil compaction and enhance water infiltration. Livestock favor brassicas as a forage crop, but producers should take extra caution when grazing brassicas because their nutrient scavenging abilities can contribute to nitrate accumulation in plant tissue. This guide highlights the value of canola and radish cover crops, but turnips and other mustard varieties are also recommended.

Canola

Canola, or rapeseed, (figure 9) is an annual crop commonly used in Idaho cover crop mixes. Producers in Idaho cite canola as beneficial in their mix because it successfully suppresses weeds and soil-borne pests, scavenges nutrients from the soil profile, and provides highly palatable livestock forage. In the fall, canola scavenges and prevents soil nutrients from leaching out of the root zone. Idaho cover crop soil trials found that fall forage clippings of canola contained more nitrogen than those of legumes. This high nitrogen concentration in plant tissues showcases the ability of the brassica to capture soil nitrogen and provide a good relative feed value. As a result, livestock take advantage of the nutrient-rich fall growth, evident with first choice preference by livestock in grazing demonstration trials. A fall planting of canola or rapeseed and a compost application will help capture and release nitrogen and phosphorus from the fall-applied compost to the following spring-planted cash crop.

Canola growth can be variable in a short growing window, but the crop is best for an early fall planting with 50 days of growth or more, or under a full season of growth. Canola will survive the winter, but spring growth is limited under Idaho growing conditions. Canola performs best in adequately fertilized soils. In a cover crop mix, canola can out-compete other species with its fast germination and growth during the warmer months. Reduce the seeding rate of canola if equal dominance of other species in the mix is desired. Planting canola with a cold-hardy legume and grass makes an excellent fall or full-season forage mix.

Radishes

Oilseed radish (also known as daikon radish, forage radish, and tillage radish) is a cool-season radish most beneficial for scavenging soil nitrogen and phosphorus, reducing soil compaction, and suppressing weeds. Oilseed radish (figure 10) is most suitable as a fall-planted cold-hardy cover crop. Oilseed radish has a large taproot that grows 2 to 3 inches in diameter and 1 foot or more in length. The thick taproot absorbs nitrogen and phosphorus more efficiently and at greater depths than most crops. The absorbed nutrients become available to the next crop through decomposition, making radishes an effective nutrient-cycling cover crop. Radishes are recommended for soils with high nitrate and phosphorus levels to increase absorption and decrease nutrient leaching. A fall planting of radish and a compost application will help capture and release nitrogen and phosphorus to the following cash crop.

Idaho producers have used oilseed radish to control nematodes. Consult with a seed dealer to purchase oilseed radish varieties that exhibit more nematode control; some oilseed varieties can be a host or attract nematodes. Planting oilseed radish in a mix of more

Figure 9. Canola is high yielding and highly palatable for livestock. Photo by Christi Falen.

Figure 10. Oilseed radish works well as a cool-season cover crop. It can also be used to control nematodes. Photo by Christi Falen.

than one cold-hardy legume and grass species provides an excellent fall and spring forage mix. Radishes can dominate in a multi-species mix. Reduce the seeding rate of radish if equal dominance of other species in the mix is desired.

Other Cover Crops

Other cover crop species grown in Idaho not listed in this publication include soybeans, grazing corn, buckwheat, millet, and bin run cereals. Figure 11 includes additional species recommended by the Natural Resources Conservation Service. Growers are urged to select and place their seed order three months before planting because some species are not readily available and it may take the supplier time to source and ship the seeds.

Grazing Management Strategies

Integrating cover crops into a crop and livestock system can be economically advantageous and biologically efficient. Properly managed livestock in a cropping system provide a free source of nutrients and an efficient nutrient cycling system. A grazed field of cover crops provides soil nutrients from both cover crops and the distribution of livestock manure. Livestock manure can return up to 75 percent of the consumed nutrients back into the field. The grazing activity also helps to break down and mix plant matter through ruminant and hoof action, speeding up decomposition.

To utilize and control the nutrients in livestock manure, it's important to have a high-density stocking rate. Management intensive grazing or controlled grazing allows producers to manipulate the location and

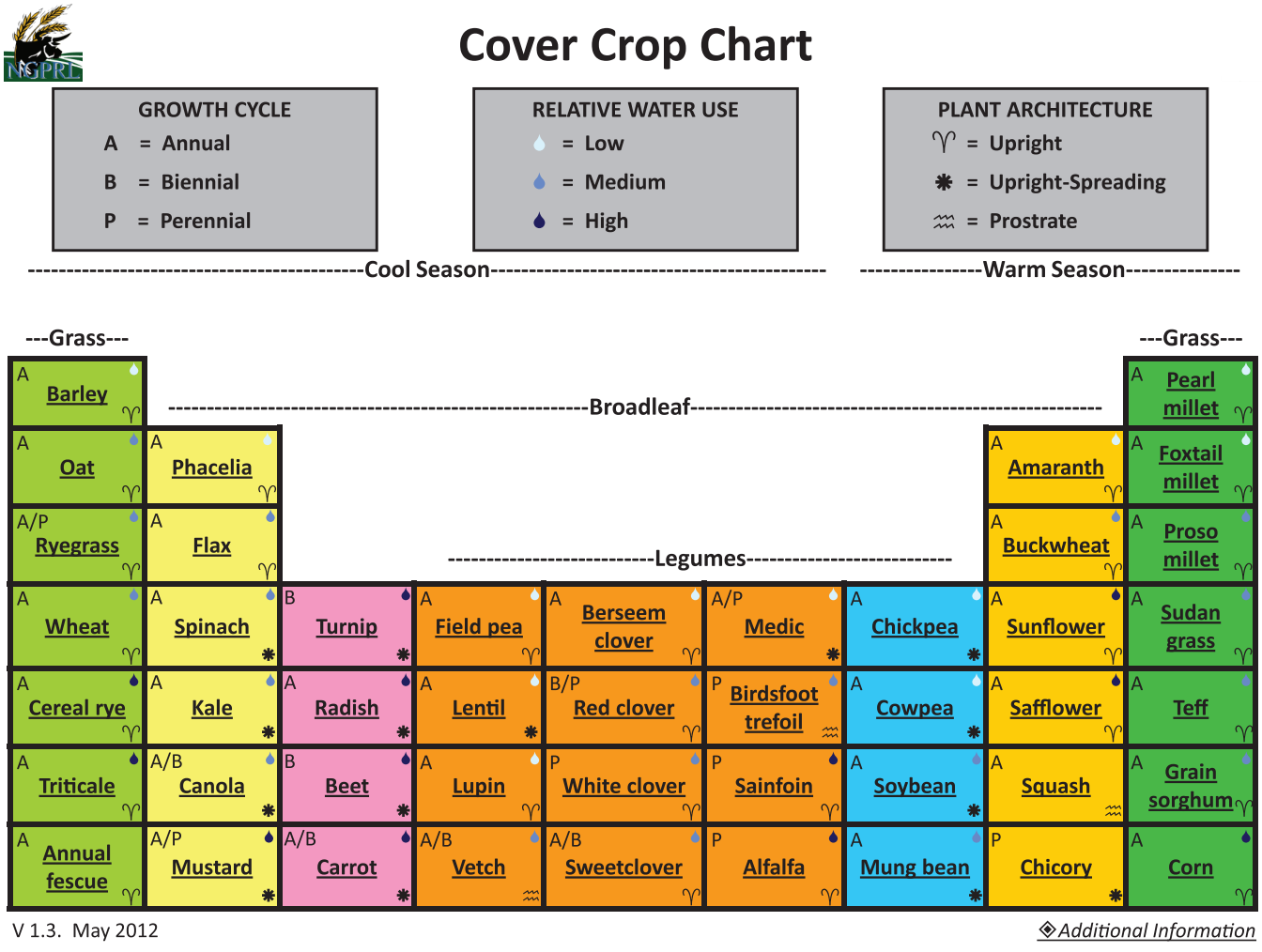

Figure 11. Use this chart to determine optimal species for a full-season, spring, or post-harvest planting. The cover crop chart is produced by the Northern Great Plains Research Laboratory with information sourced from the Midwest Cover Crops Council, USDA-SARE, USDA-NRCS PLANTS database, and additional peer-reviewed journal article resources.

duration of active grazing. Controlled grazing is a process of matching plant and animal requirements to increase the harvest of solar energy by plants. It requires an understanding of pasture ecology, control of time (rest and graze periods), and control of stock density (animal numbers and paddock size). The use of movable electric fences allows producers to create different sized paddocks that can be easily moved. Producers control feeding and in return receive multiple benefits from this management style, including improved soil health, increased feed availability, and cattle that are more efficient at harvesting available feed.

Animal considerations

One major factor to consider when choosing a cover crop is the age of cattle you plan to graze. Estimating standing feed and its quality, along with calculating the proper paddock sizes, is essential for ensuring that the cattle's needs are met. Nutritional requirements vary and therefore protein supplementation may be needed depending on the time of year and type of cover crop. Testing the forage is the most accurate way to determine feed value. However, cover crop forages are dynamic and the quality can change over the growing season. Producers can estimate cover crop dry-matter yields to evaluate feed availability, but note that cover crop dry-matter estimates can also be deceiving. For example, the large leaf area of brassicas can falsely indicate more feed than is available. In some cases, animals cannot eat enough to meet their needs because of the amount of moisture in the feed. Producers can do their own dry-matter tests to determine what is actually available for their cattle.

Plant considerations

The growth characteristics of each cover crop species determine when each is at the optimal stage for grazing. The earliest time to start grazing is when the plants are well anchored and the grasses in the mix reach the tillering stage. Therefore, in a multi-species mix the cereal crop can be an indicator of when to turn in the livestock. Livestock need to be turned in before the cover crop attains the ideal stage, as it will continue to mature while the livestock are in the field. Cereals are highly desirable to livestock at the soft dough stage and before the boot stage. If cereals go to grain, livestock no longer favor them, and the awns can irritate eyes, lips, and noses. The crops' height can also be used as a grazing indicator, with erect plant types usually 8 to 10 inches in height and prostrate types 4 to 6 inches high. University of Idaho Extension conducted a comparative grazing study for two grazing seasons to determine selection preferences of cover crops. Researchers observed that cattle showed a strong preference for brassica species first, cereals second, and then legumes.

Grass varieties that are not winter-hardy should be grazed before tillering to retard growth and subsequent premature stem elongation and head initiation. When stem elongation occurs, immature heads are located just above the highest joint (node). If these are removed, tiller death occurs. While the grass is usually able to produce more tillers, forage production is severely reduced. For crops intended for grain recovery or hay production, use the position of the immature head in the stem to determine the latest time for grazing and the severity of grazing. Some growers opt to graze late and remove these heads, particularly if the crop or variety is prone to lodging. These growers choose to accept lower grain or hay yields as a trade-off for having a standing crop at harvest. If regrowth is desired, then grazing before flowering of all species is critical. With a winter-hardy cover crop mix, deferring early grazing results in more available feed.

Soil considerations

Research shows that grazing cover crops has little impact on soil compaction. Soil compaction from grazing is affected by moisture conditions and the amount of residue in the field. Freeze-thaw cycles after grazing may alleviate any minor effects of soil compaction from grazing. Additionally, the benefits of nutrient cycling and the added feed resource may outweigh any negative impacts that might occur.

If allowed enough growth time, one of the main benefits of using cover crops is to add organic nitrogen and increase organic matter in the soil. A yearly soil test can help indicate whether soil nitrogen and organic matter are increasing with the use of cover crops. If organic matter increases by even 1 percent, it equates to greater soil tilth and water-holding capacity. It takes years to build soil organic matter content. If tillage is a common practice, the soil is not likely to see much more than a 1-year increase in organic matter, only to decrease again. Tillage does not aid in permanent organic matter buildup.

Cautionary Grazing Concerns

Some cover crop enthusiasts believe that having livestock graze the land after cropping systems is the final step in making a cover crop program highly sustainable. However, cover crop promoters who are also in the beef cattle business identify factors that should be considered before livestock use cover crops for forage. Most notably, nitrate and prussic acid poisoning can kill livestock that eat forages stressed by severe environmental conditions such as frost or drought.

Nitrates

Nitrates occur naturally in all forages because plants use nitrogen from the soil for growth and development. However, when environmental stresses prevent the plant from converting the nitrogen into plant protein, nitrate levels remain elevated. An animal that eats forages with an unusually high concentration of nitrates can suffer from asphyxiation, or a lack of oxygen. Nitrate poisoning can occur slowly or as an acute toxicity, depending on the nitrate level in the forage. If symptoms are caught early, livestock can be treated with veterinary care. To avoid risk of nitrate poisoning, never turn hungry animals out into a field of cover crops that are possibly high in nitrates. Let animals gradually graze on susceptible species, and limit grazing by diluting high-nitrate forage with low-nitrate feed. Reference table 1 for nitrate levels and feed safety guidelines.

Cover crops with long taproots, primarily brassica species that scavenge nitrogen from the soil profile, are susceptible to high levels of nitrates. Brassicas can also contain high levels of glucosinolates, which affect thyroid function. Producers should provide iodized salt during the grazing period in this scenario. Other small grain forages, such as pearl millet, barley, and wheat, have extensive root systems that allow the grass to scavenge nitrogen readily in the soil, risking high concentrations of nitrates under dry conditions.

Grass tetany

Cereal forages may produce nutritional conditions for high grass tetany risk, especially in a monoculture and when fertilized with nitrogen. Adding legumes and brassicas to the mix will reduce the grass tetany risk.

Prussic acid

To mitigate the risk for prussic acid poisoning, Sudangrass and sorghum-Sudangrass hybrids should not be grazed for 2 to 3 weeks after a frost, as discussed previously. Because prussic acid can dissipate, grazing can resume after a forage test indicates safe feeding levels. Prussic acid levels can also be affected by soil fertility. Soils high in available nitrogen and low in phosphorus increase the potential for prussic acid.

Additionally, leaf blades contain higher levels of prussic acid than do leaf sheaths or stems. Prussic acid reaches higher concentrations before the boot stage or before the plant reaches 18 to 20 inches tall. Producers should wait to graze any cover crops in the sorghum family until they are 2 to 3 feet tall, allowing the stalk to make up the greater proportion of the plant and reducing prussic acid content. Graze sorghum regrowth with caution in poor growing conditions or after environmental stresses.

Table 1. Cattle forage-nitrate feeding guidelines.

Method of reporting nitrate level				
Nitrate (ppm NO_3)	Nitrate (% NO_3)	Nitrate nitrogen (% NO_3-N)	Potassium nitrate (% KNO_3)	Recommendations for feeding
0.0–4400	0.0–0.44	0.0–0.10	0.0–0.73	Safe to feed in all situations.
4400–6600	0.44–0.66	0.10–0.15	0.73–1.10	Safe for non-pregnant animals. Limit to 50% of dry matter diet for pregnant animals.
6600–8800	0.66–0.88	0.15–0.20	1.10–1.47	Limit to 50% of dry matter diet.
8800–15400	0.88–1.54	0.20–0.35	1.47–2.57	Limit to 35–40% of dry matter diet. Avoid feeding to pregnant animals.
15400–17600	1.54–1.76	0.35–0.40	2.57–2.93	Limit to 25% of dry matter diet. Avoid feeding to pregnant animals.
Over 17600	Over 1.76	Over 0.40	Over 2.93	**DO NOT FEED**

Source: Adapted from a table by C. J. Sniffen and L. E. Chase. 1981. "Nitrates in Dairy Rations," Department of Animal Science, Cornell University.

Herbicides

Herbicides are another concern. Producers using them must be aware of grazing intervals after herbicide application. Herbicide labels can restrict the use of cover crops for forage. Most herbicides commonly used with annual crops, with the exception of glyphosate, also have restrictions on how soon other crops can be planted following application. If the herbicide label doesn't specifically list a cover crop species, the rotational restriction is automatically set at the maximum interval because sufficient tests have not been conducted on that specific species. If the cover crop isn't listed on the herbicide label, using the cover crop as feed before the maximum interval is illegal and may result in severe penalties.

Economics

The financial benefits of using cover crops can be difficult to quantify. While there are ways to immediately quantify nitrogen fertilizer savings from the use of legumes as cover crops, it's more difficult to quantify medium- and long-term financial benefits from overall soil improvement. However, as soils improve over the years with the use of cover crops, this financial evidence can become clearer.

Deciding how much to spend on seed will depend on your cover crop management goals. For example, a higher seed cost is associated with a cover crop mix used to bring diversity and improve soil health, with a cost ranging from $40 per acre and up. Cover crops used to simply cover the ground and decrease wind erosion cost an estimated $20 per acre.

Feed income

Grazing cover crops will provide immediate income to help cover the expense, with the amount of financial return depending upon the amount of feed produced. While the crop produces more pounds per acre at full maturity, it will not be as palatable for the grazing animals. Grazing is usually measured in Animal Unit Months (AUMs). This measurement is not calculated the same in all publications, but usually is measured as 800 to 915 pounds of dry matter for a 1,000-pound cow and her calf up to 6 months of age. The mature forage production numbers give an estimate of crop potential, providing a starting point to help calculate the AUMs produced per acre. Using nine on-farm demonstration sites in Idaho, the average yield was 5,190 pounds per acre of dry matter from cover crops planted by the middle of August and sampled in early November.

The cost of an AUM is very locale-dependent—according to the supply and demand of grazing ground in a particular area. The normal cost for grazing crop ground is anywhere from $20 to $50 per AUM in southern Idaho. Production of 5,190 pounds of dry matter can be easily converted to income by dividing the number of pounds produced by the number of pounds/AUM (5,190 ÷ 850 = 6.1 AUMs per acre). However, cattle or other grazing animals don't consume every last bite, and have a tendency to trample and foul the forage, especially if it's more mature. Studies estimate grazing efficiency of crop ground at about 35 percent. This cuts the available AUMs to 2 AUMs per acre. Using an average cost of southern Idaho AUMs at $35, you get a theoretical income of $70 per acre. This does not reflect the cost of fencing, water developments, or any other additional costs associated with grazing.

Grazing costs

Costs associated with management intensive grazing should be considered before deciding to plant cover crops to extend the grazing season. The following University of Idaho study can be used to pencil out the purchases needed for a controlled grazing system. In this study, using a 20-acre field divided into four blocks, the single largest expense was the cost of the charger for the fence. Several brands are available, but what worked best for this study was a 12-volt battery system with a solar panel station attached to a tee post. The battery system cost $200. High tensile wire can be purchased in ¼-mile to ½-mile rolls for $35 to $50 depending on the brand. Two or three winding reels at $25 per reel are also necessary, along with five to 10 metal tee posts. What type of post you choose for your electrical wire may depend on your tolerance for input costs. There are many choices that vary in quality, from fiberglass hammer-in posts costing $1.25 each to poly step-in posts costing $3 each.

Feed savings

Producers who graze their own cover crops can also appreciate reduced spending for hay during the time of cover crop grazing. Using the above information, if grazing 100 acres with 50 1,000-pound cows and calves,

one should be able to graze the 100 acres for 2 months. These 50 cows for 2 months would otherwise need 47 tons of southern Idaho feeder hay at a cost of $140 per ton, which means a savings of $6,580:
850 lb/AUM ÷ 90% [dry matter for hay]
= 944 lb of hay/month/head for 2 months
= 0.94 tons/head × 50 head = 47 tons.

While every cover crop grower in every situation may not realize these savings, these calculations show that grazing in the fall, winter, or early spring can bring real savings. However, if the cost of the seed were $200 per acre for the same 100 acres, the hay savings would be meager in relation to the $20,000 cost of seed. Overall, the seed cost is a critical element in cover crop management. Seed costs exceeding $50 per acre appear to lose their value in relation to dual-purpose cover crop economics.

Conclusion

The decision of whether to use cover crops as part of a farm strategy to hold soil through the winter, add nitrogen to the soil, or as a grazing resource for a cattle operation remains up to each individual. Besides the soil conservation benefits, research confirms that planting cover crops increases crop yields on most soils. We hope that the information provided in this guide will help you make sound decisions about planting cover crops and managing them appropriately.

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