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Cover Crops for High-Desert Farming Systems in Idaho

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Introduction

A cover crop is any crop grown to provide living ground cover. It can be planted with the main crop or in rotation with it.

Growing cover crops is a best management practice to help minimize soil erosion, prevent nutrient leaching, provide nitrogen (N) for subsequent cash crops, suppress weeds, sequester carbon, increase crop diversity, and provide beneficial insect habitats. In Idaho, cover crops can be planted in spring, summer, or fall and rotated with a variety of crops, including barley, alfalfa, potato, sugar beets, beans, and vegetables.

By planting cover crops, Idaho producers benefit from the following:

- Lower N fertilizer costs
- Higher soil organic matter contents
- Less wind erosion
- Scavenging and retention of soil nutrients
- Weed or insect control
- Production of a dual-purpose alternative forage

This guide features optimal cover crops for high-desert farming systems in the intermountain West under irrigated or low-moisture conditions. The specific species and varieties listed in this publication were tested under Idaho growing conditions through numerous on-farm research trials. The species were selected based on cold hardiness, biomass production, N fixing and scavenging abilities, and forage potential. For each species, information includes optimal planting dates, N contribution, biomass production, recommended cover crop mixtures, and estimated cost for cover crop seed.

The cover crop species are divided into three groups: (1) cereal and grass cover crops, (2) N-fixing cover crops, and (3) brassica cover crops (includes radish, turnip, mustard, and canola). Depending on your cropping system, the species can be mixed to achieve multiple management goals.

Figure 1. A cover crop mixture of canola, triticale, clover, and vetch helps to scavenge nutrients, increase organic matter, fix N, and control weeds. This multi-species cover crop was planted in Lincoln County, Idaho, following grain harvest.

For additional general information on cover crop seeding, refer to "Recommended Cover Crop Seeding Methods and Tools," which is listed in the references section.

Nitrogen and Organic Matter

Cover crop selection should be based on the cropping system's needs, such as improving soil conditions or managing weeds and pests. Planting a mixture of two or more cover crops can help add N to the soil, increase soil organic matter, scavenge nutrients, and control weeds (figure 1).

Nitrogen-accumulating crops (legumes) and N-scavenging cover crops (brassicas) can reduce the need for N fertilizer. The availability of N from cover crops is dependent on the N content in the cover crop plant tissue, incorporation method, incorporation timing, and amount of biomass. For example,

incorporation of a thick stand of N-rich hairy vetch can contribute a significant amount of N to the following crop, while incorporation of N-poor triticale residues can likely tie up N in the soil. Tools like the Idaho cover crop calculator and publications like *Estimating Plant-Available Nitrogen Release from Cover Crops* can help growers estimate the N contribution from planted cover crops (see references and further readings).

Legumes do not provide as much organic matter as grasses or grains. A cover crop mixture that contains a combination of legumes and small grains or grasses contributes N and organic matter (figure 2). If growing dual-purpose alternative forage is a goal, producers should plant species with good forage potential that are safe to graze at a higher seeding rate (figure 3). Dual-purpose cover crops allow producers to gain an economic advantage by grazing the crop before using its residue for soil management.

Figure 2. A cover crop mixture that contains legumes and a winter cereal contributes both N and organic matter to the soil. At left is a hairy vetch and triticale mix; at right is an Austrian winter pea and triticale mix, Kimberly, Idaho.

Figure 3. A higher seeding rate of canola, triticale, clover, and vetch makes this dual-purpose cover crop mix ideal for forage, Minidoka County, Idaho.

Winter Hardiness, Tillage Practices, and Irrigation

How producers plan to incorporate or manage residue with their available equipment will determine which species will work best. Some growers may prefer a cover crop that dies in the winter, which makes residue easier to manage in the spring before cash crop planting. In contrast, species that survive the winter are beneficial for producers looking to maximize yield, resulting in higher contributions of N and organic matter from additional spring growth. Dual-purpose cover crop mixtures should include species that produce both fall and spring forage. Cover crops that winter-kill are advisable for producers who are new to cover crops.

Common methods used to terminate cover crops in the spring include tillage, herbicide, winter-kill, mowing, and roller/crimper. Moldboard plows, rotary tillers, chisel or disking plows, and spaders are examples of tillage tools.

Producers who do not want to incorporate cover crops or employ minimum tillage can utilize no-till, strip-till, or mulch-till equipment to plant succeeding crops into existing residue. This practice is beneficial for controlling weeds and minimizing disturbance to the soil. However, under Idaho's low-moisture environment, not incorporating cover crop residue will slow the release of N.

Producers can plant cover crops by broadcast seeding with or without light incorporation of seed. Good seed-to-soil contact and sufficient irrigation during germination will ensure a good stand. Cereal producers have the option to interseed cover crops into existing cereal stubble in the fall or disk the field prior to planting cover crops. Cover crops interseeded into cereal stubble can be grazed in the fall for a dual-purpose forage and cover crop mix.

Cereal and Grass Cover Crops

Cereal grains and grasses are successful cover crops because they contribute organic matter to the soil, reduce seed costs, are widely available, can be planted with existing equipment, germinate quickly, require minimal water, and increase residue yields when planted with a legume. In Idaho, cereal and grass cover crops are a good option to plant after a fall harvest and leave for winter coverage. The large amount of residue protects the soil surface from wind erosion, helps hold soil nutrients, and conserves soil moisture.

Grains and grasses can be used as N catch crops, scavenging residual N from fall-applied fertilizer or manure/compost. This use of cereals and grasses will help minimize N loss and conserve residual N for the following growing season.

For forage use, cereal cover crops can be planted in the spring, summer, or fall and used for fall and spring grazing. A residual 3 to 4 inches should be left for winter coverage and spring regrowth. The species and varieties listed here are selected based on cold hardiness, forage quality, yield potential, and flexibility in a cover crop mix.

Even though rye grows well in Idaho, it is not included in this publication due to producer concerns with grain crop contamination. Following grain harvest, volunteer grain stubble can be a part of your planted cover crop mix.

Pearl Millet

Pearl millet, a warm-season annual grass, provides beneficial ground cover and organic matter (figure 4). It is most-widely grown in the southern U.S. as a high-nutritive-value emergency forage. It is a tall, erect grass that produces several stems from one plant. It has an extensive root system, making it very drought tolerant as well as a good nutrient scavenger. It does not yield as much as sorghum Sudangrass but is safer for grazing during the growing season because it doesn't have any prussic acid. Pearl millet is considered a low-input crop; however, it does not tolerate waterlogged soils.

Biomass production: Medium dry matter yields

Cold hardiness: Dies at the first frost. The best time to grow pearl millet in Idaho is typically from June through September or early October.

Planting dates: Summer, early fall

Mixtures: Grows well with peas and other legumes.

Seed cost: Medium

Sorghum Sudangrass

Sorghums and sorghum Sudangrasses are warm-season annuals commonly grown for forage (figure 5). Special Effort, Enorma, HayKing, Forage King, Cadan, and Nutri-Plus sorghum Sudangrasses have all performed well under Idaho growing conditions. Their fast growth and large biomass production are beneficial for suppressing weeds and adding organic matter to the soil.

Sudangrass can be grown on a variety of soil types, survive in poorer soil, improve worn-out soils, and penetrate compacted soil. It is drought resistant and can scavenge nutrients due to its many secondary roots. When grazing livestock on Sudangrass, producers need to test plant tissue to avoid the risks of high concentrations of nitrates and prussic acid. After Sudangrass dies in the fall, the prussic acid dissipates, but the nitrates do not.

Biomass production: High dry matter yields

Cold hardiness: Dies at the first frost. The best time to grow Sudangrass in Idaho is typically from June through September or early October.

Planting dates: Summer, early fall

Mixtures: Best planted alone in order to obtain maximum amounts of organic matter for soil incorporation and good weed control. It can be mixed with other species at low seeding rates. Alternate-row planting is an option to keep Sudangrass from shading out other planted species.

Seed cost: Medium

Figure 4. A mid-June planting of pearl millet in August (left) and a mid-August planting of pearl millet in October with some frost kill, Kimberly, Idaho.

Figure 5. High-yielding, June-planted sorghum Sudangrass after one month's growth, Kimberly, Idaho.

Triticale

Triticale is an annual cereal crop that produces a large amount of biomass in a relatively short period of time. 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. Triticale is beneficial for both animal forage and as a cover crop.

Biomass production: Medium to high dry matter yields depending on the N available in the soil. High dry matter yields when planted with a legume.

Cold hardiness: Winter varieties survive the winter; spring varieties do not.

Planting dates: Spring, summer, fall

Mixtures: Plant with a legume, a brassica, or in a larger mix of species.

Seed cost: Low

Winter Barley

Barley is a high-yielding annual cereal crop commonly grown for forage and hay production. It matures early, making it beneficial for early grazing with sufficient time for regrowth as a cover crop.

Biomass production: Medium to high dry matter yields depending on N available in the soil. High dry matter yields when planted with a legume.

Cold hardiness: Winter varieties survive the winter; spring varieties do not.

Planting dates: Spring, summer, fall

Mixtures: Plant with a legume, a brassica, or in a larger mix of species.

Seed cost: Low

Figure 6. Winter barley (left) and Willow Creek winter wheat (right) in June after a fall planting. Notice Willow Creek winter wheat has not yet reached the reproductive stage. Crops that stay in a vegetative stage longer release N later in the season than do early maturing grasses.

Winter Wheat

Winter wheat is an annual cereal forage that can grow under irrigated or dryland conditions. Winter wheat yields are usually lower than those of triticale but higher than those of barley under irrigated conditions.

One tested cold-hardy winter wheat variety, Willow Creek, is awnless, which makes it preferable for livestock forage. It also stays in a vegetative stage longer than does triticale or barley (figure 6). Crops that stay in the vegetative stage longer release N later in the season than do early maturing grasses. Other spring or winter wheat varieties can be used, depending on local seed availability.

Biomass production: Medium to high dry matter yields depending on the N available in the soil. Low to medium yields under dryland conditions. High dry matter yields when planted with a legume.

Cold hardiness: Survives the winter.

Planting dates: Fall

Mixtures: Plant with a legume, a brassica, or in a larger mix of species.

Seed cost: Low

Nitrogen-Fixing Cover Crops

Peas, vetches, and other legumes are beneficial cover crops because they contribute N to the soil. The symbiotic rhizobia bacteria that live inside nodules on their roots fix atmospheric N (figure 7). The N within the plant tissue is in the form of proteins. A high protein content is what also gives legumes a high nutrient value for animal forage.

Due to their higher seed cost, it is beneficial to plant legumes in a mix with cereal crops, reducing the seeding rate of legumes and supplementing with a less expensive

Figure 7. Large root nodules on Austrian winter peas fix atmospheric nitrogen, Shoshone, Idaho.

cereal seed. Cover crop research in Idaho revealed higher yields when legumes were planted with a cereal crop than in a 100% legume mix. The species and varieties listed here were selected based on cold hardiness, forage quality, and higher potential N contribution.

Arvika Forage Peas

Arvika forage pea—an annual pea with long vines—is planted for its high yields and quality forage (figure 8). In Idaho, Arvika forage peas have surpassed Austrian winter peas for fall dry matter yields. This pea provides weed control in the fall with its fast growth and in the spring with its dense residue covering the soil surface.

Arvika forage pea is well suited for early spring N release because the pea dies in the winter and the residue starts to break down, releasing N in early spring. Unlike Austrian winter peas and hairy vetch, it does not require soil incorporation to release plant-available N. Arvika forage peas die in the winter and are recommended for organic systems.

Nitrogen contribution: Medium to high

Biomass production: Large dry matter yields when planted alone or with cereal crops

Cold hardiness: Does not survive the winter, but can survive repeated temperatures below freezing for short periods in the fall.

Planting dates: Spring, summer, fall

Mixtures: Plant with a cereal cover crop, brassica, or both.

Seed cost: Medium. Currently seed not widely available.

Austrian Winter Peas

Austrian winter peas (figure 9) are an excellent cover crop due to their adequate yields, excellent N contribution, and forage value. Irrigated Austrian winter peas planted in Aberdeen, Idaho, produced 219 pounds of plant-available nitrogen per acre after plowdown. Other trials in Idaho found Austrian winter peas to survive and produce adequate biomass under limited irrigation. Research in Montana found that spring-planted malting barley had a higher protein content after a fall planting and spring plowdown of Austrian winter peas than when grown after other legumes or a fallow system.

The purple flowers attract beneficial insects and provide nectar for honeybees. Austrian winter peas are easy to kill with disking or mowing after full bloom stage. Plant peas for winter grazing early in the fall; plants that have more growth left in the fall are more susceptible to winter kill.

Nitrogen contribution: High

Biomass production: Medium dry matter yields

Cold hardiness: Cold hardy, with 50–75% surviving the winter

Planting dates: Spring, summer, fall

Mixtures: Plant with a cereal or in a multi-species mix.

Seed cost: Medium to high

Figure 8. Arvika forage peas (center) surrounded by sorghum varieties on October 1, 2013. Crop planted August 14, 2013, Kimberly, ID.

Figure 9. Higher-yielding Austrian winter pea growth in front of a slower-growing chickling vetch, Shoshone, Idaho.

Chickling Vetch

Chickling vetch is an annual viney pea (figure 10). In Idaho under irrigated conditions it does not provide as much N in the fall as hairy vetch, Austrian winter peas, or Arvika forage peas. However, if it is planted in the spring and allowed to grow the entire growing season, it can produce more biomass and provide more N than they do. Chickling vetch can perform well under limited irrigation with a full season of growth. Unlike hairy vetch, chickling vetch will die in the winter, making it more suitable for organic systems.

Nitrogen contribution: Low to medium

Biomass production: Low to medium dry matter yields

Cold hardiness: Dies after a heavy frost.

Planting dates: Spring, summer

Mixtures: Plant alone or with a cereal crop.

Seed cost: Medium

Cicer Milkvetch

Cicer milkvetch is a perennial legume that spreads by rhizomes (figure 11). This species is best suited as a long-term cover crop or in a pasture mix. In Idaho, cicer milkvetch has had lower yields compared to other species. Due to its rhizomatous root system, cicer milkvetch is good for erosion control and is considered a good option for revegetating disturbed areas at higher elevations. The showy flowers are good for home garden use and for attracting beneficial insects. Cicer milkvetch is not good for weed control because it germinates and grows slowly.

Nitrogen contribution: Low N contribution due to low production

Biomass production: Low dry matter yields

Cold hardiness: Cold hardy; survives the winter.

Planting dates: Early spring, summer

Mixtures: Plant cicer milkvetch with a cereal or grass.

Seed cost: Low to medium

Clovers

Clovers are commonly planted in a pasture forage mix because they improve forage quality and contribute N to the soil. Clovers are best suited for longer growing periods because they are slow to establish and produce less biomass compared to other legumes. As a result, they are expensive cover crops if only planted for a short period.

Hairy Vetch

Hairy vetch is a vine-like, vigorous annual cover crop that behaves like a perennial (figure 12). It is widely planted as a cover crop because it accumulates high levels of N. Hairy vetch typically pays for itself with its heavy N contribution in addition to its other soil-improving benefits. Hairy vetch improves soil structure, increases soil biological activity, and promotes soil moisture retention. The vetch residue is thought to create more stable soil aggregates (particles), promoting better soil structure and moisture retention.

In Idaho, a hairy vetch mix conserves more spring soil moisture than a field planted in cereal rye or a field with no cover crop. Hairy vetch planted at high seeding rates can suppress weeds. Its fast spring growth helps to outcompete weeds by shading the soil surface. Hairy vetch also proves to be drought-tolerant and can survive on a variety of soil types and under marginal field

Figure 10. Chickling vetch yields vary, but a full growing season offers higher yields. Crop planted August 14, 2013, photographed on October 10, 2013, Kimberly, ID.

Figure 11. Cicer milkvetch is a slow-growing species, more suitable for a long-term planting than a short-season cover crop.

conditions. However, for organic systems hairy vetch can become a weed problem; its persistent nature makes it difficult to kill with tillage alone.

Nitrogen contribution: High

Biomass production: Medium dry matter yields

Cold hardiness: One of the more cold-hardy legume cover crop species; it survives the winter.

Planting dates: Spring, summer, fall

Mixtures: Blending hairy vetch with a cereal or grass allows the vetch to climb the cereal stems, optimizing photosynthesis and helping to lift and detangle the vetch vine for better mechanical control for residue management.

Seed cost: One of the more expensive legumes

Brassica Cover Crops

Optimal brassica species for high-desert cropping systems include canola or rapeseed, radish, mustards, and turnips. The large taproot and/or horizontal roots on these cover crops allow them to scavenge nutrients deep in the soil profile. When planted in the fall, the taproots help to capture residual soil nutrients such as N and phosphorus. Rapid spring decomposition release these nutrients back into the soil for the succeeding crop.

The taproot also penetrates deep into the soil, helping to mitigate subsoil compaction. Research in northern Idaho shows that the taproots of canola, oriental mustard, and yellow mustard improve soil structure and water-holding capacity and reduce nitrate leaching.

Livestock favor brassicas as a forage crop, but producers should be aware that their nutrient scavenging abilities can contribute to nitrate accumulation in plant tissue.

Brassicas grow rapidly in the fall and spring, providing excellent soil coverage for weed control. In potato systems, brassicas are used to manage pests. The cover crops release chemical compounds that are toxic to some soilborne pathogens and pests such as fungi, nematodes, and some weeds. Mustards typically have a higher concentration of these chemicals.

This publication includes only canola and daikon radish, but other radishes, turnips, and mustards are equally suitable and perform well under Idaho growing conditions. Brassica cover crops work well planted alone or in a cover crop mix.

Canola

Canola, an annual, is a trademarked cultivar of rapeseed (figure 13). As a cover crop, canola is used for controlling erosion, suppressing weeds, controlling soilborne pests, alleviating soil compaction, and scavenging nutrients. Canola needs adequate N in the soil at planting for good survival and biomass production. A fall planting of canola with a fall application of compost or manure will capture excess N and phosphorus and release them the following spring through decomposition.

Cold hardiness: Survives the winter if given sufficient time in the fall for biomass production

Planting dates: Summer, fall

Mixtures: Plant alone, with a cereal or legume, or in a larger mix of species.

Seed cost: Medium

Figure 12. A high-yielding hairy vetch crop contributes N and organic matter and provides good weed control. May-planted crop in August at a high-elevation farm, Picabo, Idaho.

Figure 13. A canola and triticale mix.

Daikon Radish

Like other radish varieties, daikon radish is beneficial for suppressing weeds, cycling nutrients, and reducing soil compaction (figure 14). It has a large taproot that can grow 2 to 3 inches in diameter and up to 1 foot or more in length. The aboveground foliage grows quickly, providing excellent weed control. A fall planting of daikon radish with a fall application of compost or manure will capture excess N and phosphorus and release them the following spring through decomposition.

Cold hardiness: Daikon radish is a cool-season cover crop but will not survive the winter.

Planting dates: Summer, fall

Mixtures: Plant alone, with a cereal or legume, or in a larger mix of species.

Seed cost: Medium

Figure 14. Large taproot on an oilseed (left) and daikon radish (right) helps till the soil and reduce soil compaction; the secondary roots on oilseed radish help to scavenge nutrients and water.

References and Further Readings

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