# Small Grain Forage Production Guide

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### *Highlights*

- Small grains such as barley, oats, rye, triticale, and wheat provide flexible forage choices for pasture, hay, or silage, fitting well into diverse rotations and water-limited systems in Utah and the western U.S.
- These crops grow across a wide range of soils and climates but perform best on well-drained, fertile soils with adequate early-season irrigation for optimal yield and forage quality.
- Multi-species mixes often boost yield and quality while extending the grazing period, though differing maturity rates can complicate harvest timing.
- Nitrogen requirements depend on yield goals and crop history; fields following alfalfa usually need little or no added N. Adequate phosphorus and potassium are also critical for productivity.
- Small grains for forage generally use less total irrigation than grain crops and benefit from early-season water applications when temperatures and evapotranspiration rates are lower.
- Effective pest management combines regular scouting, cultural practices, and careful pesticide selection, while starting with a clean seedbed and using competitive varieties helps suppress weeds.
- Harvesting at the flag leaf to boot stage yields the best forage quality, while later harvests increase tonnage but reduce protein. Proper management minimizes nitrate risks and optimizes hay or silage production.

## Introduction

Small grain forages can be used for pasture, hay, and silage and have become more common in cropping systems in Utah and the western United States. The most common small grain species used for forage production are barley, oat, rye, triticale, and wheat. These species are grown individually or in various combinations and can provide many options for planting in the fall or spring. Small grain forages are versatile and can serve effectively in rotations, as dual-purpose options, double-cropped systems, cover plantings, emergency solutions in response to weather extremes, failed plantings, or drought and limited water conditions. Although there has been an increase in the use of small grains for forage production in the western U.S., little published information is available on best management practices for small grain forage production. This guide will discuss the key production practices for small grains used for forage.

## Site Selection

Small grain forages are a flexible option that can fit into many operations across Utah and the western U.S. These crops are well-suited to a wide range of environments and **can be grown almost anywhere in this region**. They generally perform best in cool, dry conditions, but certain species and varieties can tolerate temperature extremes and even grow in saline soils where other crops would struggle (Barker et al., 2023).

While small grains can grow in a variety of soil types, well-drained, fertile soils are ideal. Better soil conditions lead to higher yield potential and improved forage quality. Poorly drained or compacted soils can limit root development and reduce stand vigor, especially under irrigation. Test the soil before planting and correct any nutrient deficiencies, especially nitrogen (N), phosphorus (P), and potassium (K), as these nutrients are critical to achieving good crop yield and forage quality.

**Understanding field history is also key**. Repeatedly planting small grains in the same field can lead to disease, insect, and weed issues. A diverse crop rotation that includes broadleaf species or perennial forages can help break pest and disease cycles and support long-term soil health. Keep in mind that your previous crop also affects your fertility program, and some rotations may require adjustments to nutrient applications.

Finally, **water availability is an important factor**. In most areas of Utah, small grain forages will need at least some early-season irrigation to reach a profitable yield level. This is especially true in years with limited spring moisture. Or if fall plantings are desired, irrigation is needed in late summer/early fall when water availability is often scarce. Timely irrigation during early growth stages (such as tillering and stem elongation) can have a significant impact on final yield and forage quality.

## Species and Variety Selection

When selecting a small grain species and variety, it is important to consider the intended harvest method and whether a variety has awns. Awns are barbed bristles that can cause mouth pain, infection, and other issues when grazed or fed to livestock in baled hay but are not a problem for livestock if the small grain forage is ensiled. Barley, wheat, rye, and triticale have awned varieties, but awnless, awnletted, or hooded varieties of some of these species are preferred. Awned varieties can be harvested for hay or grazed safely if the forage is harvested before the heading stage when awns emerge.

Small grain forages can be grown as a single species but are often grown in three, four, and five-way combinations. Common forage mixes include barley, oat, rye, triticale, and wheat. Species mixes are used because they often produce higher yields, reduce susceptibility to some insects and diseases, and can have higher forage quality than single species plantings. Growing multiple species together can also be beneficial for small grain forages in pastures because they can create a longer grazing period by reducing the risk of a single peak growth period in the spring (Lemus, 2017). Small grains are also sometimes used as cover crops or companion crops that can be harvested for forage thereafter.

One of the disadvantages of growing multiple species together is the differing maturation rates and timings of each species. This can make it difficult or impossible to harvest all the species at their ideal growth stage for optimal forage quality. Another disadvantage of using a mix of multiple species is that some species can have limited options if a fall planting is desired. Finally, if small grains are mixed with legumes or broadleaves in a mix, it severely limits or excludes the use of selective herbicides for weed control.

Seed costs for mixes will differ because the prices for each of the individual grain species varies. They are often sold in mixes of three to five species and occasionally include a legume or other forage. In 2024, seed prices for a variety of mixes in Utah ranged from about $0.30 to $0.60/pound or $15–$30/50-pound bag of seed. Two-, three-, and four-way mixes are typically made custom on a case-by-case basis by seed suppliers, and pricing may be slightly different depending on variety selections. ***Be sure to factor in the cost of the seed, anticipated yield and forage quality, and purpose of the forage when selecting which single species or combination to cultivate.***

**Figure 1.** Barley Growing in Southern Idaho

- **Barley** is a cool-season grass known for its high salinity tolerance [electrical conductivity (EC) threshold = 6.0 dS/m]. Forage barley is hooded and produces more leaf and biomass than grain varieties (Figure 1). Grain barley has also been used for forage and usually has awns. Barley generally yields lower tonnage than oats or triticale but produces silage or hay with greater digestibility and higher forage quality (Ditsch & Bitzer, n.d.). It can be planted in the fall or spring depending on the variety chosen, however, caution should be exercised for fall plantings as barley is not as winter hardy as some other small grains. Barley grows best on moderate to well-drained soils and normally does not produce well on heavy-textured (clay or clay loam) soils. It grows best in cool, dry conditions, but can withstand hot, dry, cold, and wet weather (Oregon State University, 2025a). Barley is drought tolerant and can withstand high elevations and short growing seasons better than most other cereal crops (Ullrich, 2010; Natural Resources Conservation Service [NRCS], 2016). If using barley for silage or hay, the boot (when head is fully developed in the swollen leaf sheath) to dough (kernels are doughy when squeezed) stage is the best time to harvest. Barley can be used for early season grazing because it is planted earlier and matures faster than wheat.

**Figure 2.** Oat Forage Crop Growing near Holden, Utah

- **Oat** – Oat is a cool-season grass and typically among the higher yielding small grain forages (Figure 2). They should be harvested for forage at early dough to maximize yield, but between boot and heading stages to maximize forage quality (Barnhart, 2011). If grown as a companion crop or in a mix, earlier harvesting is preferred to reduce competition. Oats should be grazed during the boot stage and if grazed in the fall, a minimum of 3 inches should be left to prevent winterkill (Oregon State University, 2025b.). It is the least winter hardy of the small grain forage species and winter oats must be planted in the late summer to early fall to ensure adequate establishment before winter temperatures. Oats are tolerant of strongly acid to moderately alkaline or saline soils (Table 1) and do best in well-drained soils.

**Figure 3.** Forage Rye Planted Near Cedar City, Utah

- **Rye -** Rye is a good option for a wide range of soil types due to its drought tolerance, low fertility needs, and winterhardiness, tolerating temperatures as low as -30°F once well-established (Figure 3). It breaks dormancy early, which makes it a good option for spring pasture, though the quality and palatability of the forage declines as rye matures. It is best to begin grazing when rye is 5- 6 inches tall and keep the maximum height at 8-10 inches to prevent the crop from maturing (Drewnoski & Redfearn, 2023). Rye is often planted in the fall and can also act as an effective winter cover crop. Winter rye should be harvested at the late boot stage, typically about 58-65 days after planting (Oregon State University, 2025c).

**Figure 4.** Triticale Planted Near Richfield, Utah

- **Triticale** – Triticale is a cross between wheat and rye and has both fall and spring-planted varieties (Figure 4). It is commonly the highest yielding small grain forage. It does best in well-drained soils, low to near-neutral pHs, and is moderately tolerant to saline soils (Table 1). It is well-suited for grazing, hay, and silage production. Spring triticale can be planted early and harvested for forage in roughly 58-65 days depending on spring temperatures and desired harvest stage (Oregon State University, 2025d). Winter triticale has similar planting timing to oats, having high water demands at a time when water is often scarce, but can be grazed in the fall. When harvesting for hay or silage, just before boot stage maximizes yield, but the later reproductive stages results in higher yields. If grazing, triticale is ready for grazing 2-3 weeks later than rye but retains quality for longer into the spring. Harvest timing and methods vary depending on climate and desired quality.

- **Wheat** – Wheat is most often grown for grain but can produce a high-quality forage when harvested at earlier growth stages (Figure 5). There are both winter and spring varieties available, and wheat is often quite winter hardy. Wheat will grow best in slightly acid to neutral soils that are well-drained (Table 1). Wheat should be harvested or grazed around the boot stage, having the highest total digestible nutrients (TDN) of winter small grains, but more sensitive to quality decreases with maturation (Hartschuh & Sulc, 2022). When grazing wheat, it is important to remove animals before the jointing stage to prevent yield losses for later crop harvests.

- **Species mixes** – Three-way blends of small grain species are some of the most common seed mixes (Figure 6). Four or five-way blends mostly consist of small grains, but sometimes include legumes, such as peas, to add protein. Using a mixed species forage can provide a large variety of options for harvesting. Generally, for maximum quality forage, harvest or grazing should take place at the late boot stage. These mixes are typically planted in late fall or early spring and harvested mid-June to mid-July depending on the climate and harvesting stage of the crops.


Figure 5. Wheat Grown for Forage Near Lewiston, Utah


Figure 6. Three-Way Small Grain Forage Field Near Richfield, Utah

**Table 1.**
*Soil pH, Salinity Tolerance, and Frost-Free Days Typically Required for Various Small Grains Species Used for Forage Production*

| Small grain species | Ideal soil pH | Salinity toleranc | Frost-free days[h] | Minimur tempera ** | Drought tolerance |
|---|---|---|---|---|---|
| **Barley** | 6.0–8.5[e] | Moderately tolerant | 90 | -43[h] | Medium[h] |
| **Oats** | 5.5–7.0[b] | Tolerant | 90 | -23[h] | Low[h] |
| **Rye** | 5.0–7.0[c] | Moderately tolerant | 110 | -33[h] | Medium[h] |
| **Triticale** | 6.0–7.0[f] | Tolerant | 100–110* | -20[g] | Medium[f] |
| **Wheat** | 6.0–7.0[a] | Moderately tolerant | 100 | -28[h] | Medium[h] |

*Notes*. In gypsiferous soils, plants can tolerate an EC of about 2 dS/m higher than indicated. The tolerance rating for triticale is for grain rather than forage because tolerance has not been evaluated for forage. Grain tolerance ratings are typically 1–2 dS/m higher than forage ratings.
*Frost-free days for triticale are estimated based on similar characteristics to wheat and rye.
**Cold tolerance is air temperatures during dormancy of winter varieties.

Data were obtained from [a]Vitosh (1998), [b]Valenzuela and Smith (2002a), [c]Valenzuela and Smith (2002b), [d]Grieve et al. (2012), [e]NRCS (2016), [f]Noggle and Cochrane (2023), [g]NRCS and Iowa State University Extension (2024), [h]NRCS (n.d.).

## Planting

Planting rates and depths vary depending on the crop species, planting method, and planting time. When using a traditional grain drill, recommended seeding rates range from 65–150 pounds/acre for small grain forages grown with irrigation (Table 2). Recommended rates for forage are typically higher than those for grain because higher stem and leaf density is desired. Broadcast seeding is uncommon but can be successful with light tillage using an implement such as a harrow or field cultivator to incorporate the seeds. A 20% higher seeding rate is typically

**Figure 7.** Small Grains Planted in Research Plots in Utah

recommended for broadcast applications, since some seed will remain on the soil surface and not germinate. For no-till planting, a slightly higher seeding rate (10%–15%) is often recommended if seed placement is not optimal. When planting mixes like a two- or three-way mix, the seeding rate is typically 100–120 pounds/acre for drilled (Table 2) and 120 pounds/acre for broadcast plantings.

Seedbeds should be clean and firm when planting small grains for forages (Figure 7). Loose seedbeds can cause uneven and poor emergence and increase the risk for seedling diseases (Marsalis, 2018). Field preparation and soil management are generally the same for small grains being grown for forage as for grain. Plant seeds at a depth of 1.0–1.5 inches, or deep enough to reach moisture in the soil without exceeding 2 inches. When planting mixes, the ideal seeding depth can vary among species, but planting mixes 1.0–1.5 inches deep should result in good establishment (Kearney, 2006).

Whether spring- or fall-planted, it is also important to pay attention to the planting dates for each crop to reduce risk of damage from extremely low temperatures and frost (Table 1). The winterhardiness of species should also be considered to prevent crop loss from winter conditions. Planting species mixes is similar to planting individual species, but the needs of all species should be considered.

**Table 2.**
*Seeding Rates for Common Small Grain Forages Grown as Individual and Mixed Species*

| Crop | Drilled seeding rate (lb/acre) |
|---|---|
| Wheat | 90–150 |
| Oats | 65–120 |
| Rye | 90–100 |
| Triticale | 90–150 |
| Barley | 80–150 |
| Mixed species* | 100–120 |

*Notes.* Data obtained from Kearney (2006), Min (2012), Lemus (2017), University of Arizona (n.d.), and experience of authors.

*The seeding rate for mixed species varieties can vary based on what species are in the mix.

## Nutrient Management

Small grain forages have a wide range of fertilization needs, depending on species and growing conditions. Soil testing is a useful tool for determining which nutrients are already available in the soil and for helping determine fertilization requirements before the season starts (Yost et al., 2023). Most fertilizer guidelines are similar for small grains grown as forage or grain, but recommendations for grass hay are often used as well. The current Utah State University (USU) fertilizer guidelines for wheat, barley, and oats are listed in Table 3. Please note that these guidelines are under review and may be updated soon.

- Nitrogen - Nitrogen rates for most small grains are based on expected yield levels. Be sure to set realistic yield expectations as they greatly influence fertilizer rates (e.g., a yield goal increase of 1–2 tons/acre increases recommended N rate by 25–50 pounds N/acre). Previous crops influence nitrogen fertilizer requirements. Small grain forages following established alfalfa generally require no nitrogen fertilizer to economically optimize yield in the first year after alfalfa (Yost et al., 2020). Research in Utah has shown that nitrogen fertilizer is only needed for small grain forages following alfalfa if the stand was 10 years old or older at termination. If this is the case, applying 60 pounds of nitrogen per acre can help to optimize yield.

**Table 3.**
*Summary of Current Nitrogen Recommendations for Small Grain Forages*

| Goal | Recommended N rate |
|---|---|
| Yield goal = 1–2 tons/acre | 50 lb N/acre |

| Goal | Recommended N rate |
|---|---|
| Yield goal = 2–4 tons/acre | 75 lb N/acre |
| Yield goal = 4–6 tons/acre | 100–150 lb N/acre |
| Yield goal = 6–8 tons/acre | 150–200 lb N/acre |
| Soil nitrate credit | (Goal recommendation) - 4(Soil test nitrate) |
| Alfalfa N credit[b] | No N fertilizer is recommended when small grains follow alfalfa less than 10 years old at termination. If stand is older than 10 years, apply up to 60 lb N per acre. |

*Notes.* Please see other guides (where data was obtained) for more details: "Understanding Your Soil Test Report" (Cardon et al., 2008) and "Small Grains After Alfalfa" (Yost et al., 2020).

- Other nutrients – USU fertilizer guidelines for small grain forages are currently based on grass hay guidelines. Find the fertilizer guidelines in the USU Extension article titled "Understanding Your Soil Test Report" (Cardon et al., 2008). A range of fertilizer rates are recommended when soil test nutrient concentrations (when measured to 1-foot sample depth; Figure 8) are lower than critical values (or sufficient level).

**Figure 8**. Soil Sampling in the Spring

The sufficiency value for soil test phosphorus (P) is 15 ppm. **When soil has greater than 15 ppm, no P fertilizer is recommended**. When concentrations are less than 15 ppm, P fertilizer rates are recommended up to a maximum of 125 pounds P2O5/acre as soil P concentrations decrease.

Likewise, the critical value for **potassium (K) is 150 ppm, and no K is recommended above this level.** When K is less than 150 ppm, up to 220 pounds K2O/acre is recommended as soil test K decreases.

Critical soil test values exist for other macro and micronutrients. However, recent field trials in Utah indicate that these critical values are not always indicative of fertilizer response and that plant tissue testing for these deficiencies may be a superior approach. Further, micronutrient fertilizer response has been rare in small grain forage trials in recent years. Refer to Table 3.7 of the Utah Fertilizer Guide for more information about tissue sampling of small grains.

## Irrigation

Small grains grown for forage require less total irrigation than for grain, but consistent, adequate irrigation is more important for vegetative growth and maximizing yield. Small grains require irrigation shortly after planting to ensure germination, unless rainfall occurs. One benefit of growing spring small grains is that their water use is earlier in the season when air temperatures and evapotranspiration rates are lower, when more water is often available, and they have a shorter irrigation season.

Using small grains for forage rather than grain production also tends to slightly decrease their water usage due to a shorter growing season.

Timing the cutoff of irrigation is also important for preventing lodging (bending or falling over) of small grains. For crops with shallow root zones as well as crops in sandier soils, the cutoff should be 7–10 days before the late stages of dough development. The milk stage of growth is the heaviest seed set. Irrigation water can collect in awns, increasing the weight of the grain heads at this stage, increasing the risk of lodging. For finer-textured soils and crops with deeper roots, the cutoff should be around 14–21 days before the later stages of dough development (Fulton, 2006).

In Utah, small grain forages are often grown with minimal or no irrigation. Many producers choose to plant in the fall, using available water to germinate the seeds and rely on winter moisture for subsequent growth. One problem with fall plantings is that if fall moisture is not adequate, water demands are high when irrigation availability is often low, making these crops less water-efficient than their spring counterparts. Another common practice in water-limited conditions is planting small grains in the spring. If a producer has access to high water rights or early water, crops are established early in the season, after which the plants grow without additional irrigation. Both fall- and spring-planted crops are typically harvested for hay/silage or grazed later in the season in water-limited scenarios.

## Pest Management

**Figure 9.** Russian Wheat Aphid on Wheat Leaf

Pests, including insects, weeds, and diseases, can significantly reduce the growth, yield, and forage quality of small grains. Implementing effective management techniques is crucial to minimize their impact and ensure healthy small grain forages. There are many chemical control options for small grain pests. Some of these options will be discussed below. Always verify that the pesticides are applied according to label instructions and restrictions. USU and its employees are not responsible for the use, misuse, or damage caused by application or misapplication of products or information mentioned in this document. “Restricted use” pesticides may only be applied by a licensed applicator. The pesticide applicator is legally responsible for proper use. Further, USU makes no endorsement of the products listed in this publication.

### 1. Insects

Small grains are susceptible to damage from insects. Insects can cause many issues that impact both yield and quality of small grains. Monitor fields closely to detect insect issues early, enabling more effective management. A few insects that are common in small grain forages include aphids, cereal leaf beetles, grasshoppers, Mormon crickets, and wireworms. Pay special attention to aphid control to prevent the spread of disease.

**Russian wheat aphid (Diuraphis noxia)** is a serious pest of small grains like wheat and barley, especially in dry, temperate regions like Utah. While other aphid species occur in Utah small grains, they often do not reach economically significant levels. Detection involves regularly scouting fields, particularly during early growth stages. Signs of infestation include tightly rolled leaves, white or purple streaks on leaves, and stunted, chlorotic plants (Figure 9). Russian wheat aphids are small, pale green, and lack the typical cornicles (tailpipes) seen on other aphids. Instead, they have a double tail-like structure and an elongated body shape. Planting small grains early and maintaining good plant vigor through proper irrigation and fertilization can help crops tolerate aphid pressure better. More information about detection, thresholds, and management is detailed in Hodgson and Karren (2008).


**Figure 10.** Cereal Leaf Beetle Damage
(A beetle is on a leaf near the middle left-hand side of the image.)

**Cereal leaf beetle (Oulema melanopus)** is a common pest of small grains, such as wheat, barley, oats, and rye. Scout fields and field edges in the early spring. Adult beetles are about ¼ inch long, with metallic blue-black wing covers and a reddish-orange thorax. Their larvae coat themselves in a slimy fecal shield and cause more damage than adults. Feeding damage appears as long, narrow strips between the veins of leaves (known as "windowpaning"), which can reduce yield if infestations are heavy during grain filling (Figure 10). For information on detecting and controlling cereal leaf beetle, refer to Hodgson and Evans (2007).

**Wireworms (Elateridae)** are the larvae of click beetles and are soil-dwelling pests that can cause serious stand losses in small grains like wheat, barley, and oats, especially during seedling establishment. Wireworms in small grains are best detected using bait traps placed in the soil before planting, or by scouting areas with poor emergence and digging around damaged seedlings to find the larvae. Fields previously in sod or pasture are at higher risk for infestations. Use crop rotation, delayed planting in cool soil, and possibly fallowing in extreme cases to help reduce wireworm habitat. Seed treatments with neonicotinoids (like imidacloprid or thiamethoxam) offer some protection. In high-risk fields coming out of long-term pasture or sod, soil-applied insecticides such as tefluthrin may be a good option. Refer to Karren et al. (2020) for more information about wireworms.

**Grasshoppers (Acrididae) and Mormon crickets (Anabrus simplex)** can cause significant damage to small grains by feeding on seedlings, leaves, and developing heads. To help prevent outbreaks, it can be beneficial to till and mow field edges to reduce habitat, plant early to help small grains outpace feeding damage and protect biological controls like natural predators. Scouting fields and field borders beginning in late spring is important. Treatment is warranted when thresholds exceed about eight grasshoppers per square yard in field borders or 15 in fields. Chemical controls such as diflubenzuron, carbaryl, malathion, and lambda-cyhalothrin are often effective when timed early, especially when applied in fields and to perimeters. Coordinated efforts among landowners and state or federal agencies are especially valuable during outbreaks. Learn more about grasshopper control in Evans and Hodgson (2008).

## 2. Weeds

Small grain forages are short-season, competitive crops, so weeds do not have as much opportunity to dominate as they can late in the season when a small grain is produced for grain. The competitive nature of these crops can reduce the need for weed control in small grain forages. However, it is still important to be diligent in managing weeds in small grain forages, so they do not cause problems later.

One of the most important aspects to managing weeds in small grain forages is to start with a clean weed-free seedbed and use certified, weed-free seed at planting. A clean seedbed can be accomplished with tillage or herbicides. Establishing a good stand of small grain forage also helps reduce weed pressure. Herbicides are usually applied to small grain forages after crop tillering and right before row closure. Select herbicides to target specific weed problems in the field. Manage weeds that are difficult to control in small grain forages before planting or in the rotational crop.

*Pay special attention to livestock feeding restrictions on herbicide labels. Herbicide applications with feeding restrictions a few weeks before harvest can delay harvest and cause issues.*

Some of the most common weeds that infest small grain forages in Utah and the Intermountain West include kochia, lambsquarters, pigweed, various mustards, filaree, cheatgrass (downy brome), jointed goat grass, wild oat, and Russian thistle. Effective weed management in small grains requires an integrated approach that combines cultural, mechanical, and chemical strategies. Seeding early and using competitive, vigorous crop varieties can help outcompete weeds. Crop rotation, especially with broadleaf crops, can disrupt the life cycles of grass weeds such as cheatgrass, jointed goat grass, and wild oat. For broadleaf weed control, several postemergence herbicides are available (Table 4). Like all pesticides, it is important to rotate modes of action to avoid resistant weeds. Kochia and Russian thistle are particularly problematic and are best managed through pre-plant tillage, delayed planting to allow for pre-plant weed flushes, and targeted herbicide applications. Maintaining clean field margins and using certified seeds also reduces the spread of invasive weeds.

**Table 4.**
*Some Herbicide Options for Small Grain Forage Weed Management*

| Herbicide | Crops | Weeds managed | Application growth stage | Notes |
|---|---|---|---|---|
| **2,4-D** | Wheat, barley, rye, triticale, oats | Annual, biennial, and some perennial broadleaf weeds | After full tillering to before boot | Pay attention to application restrictions. |
| **Aim** | Wheat, barley, rye, triticale, oats | Kochia, lambsquarters, Russian thistle | Prior to grain emerging | Use as a pre-plant burndown or pre-emergence spray. |
| **Clarity/ Dicamba** | Wheat, barley, rye, triticale, oats | Many annual, biennial, and perennial weeds | Prior to jointing | Low use rate tends to make it weaker on several species; see specific restrictions by grain type. |
| **Huskie** | Wheat, barley, rye, triticale | Many small broadleaf weeds including mustards, and kochia | One leaf up to flag leaf emergence | Apply to smaller weeds |
| **Maestro** | Wheat, barley, rye, triticale, oats | Mustards, lambsquarters, sunflower, kochia | Emergence up to prior to boot stage | Apply when weeds are <2 inches tall. |
| **MCPA** | Wheat, barley, rye, oats | Mustards, pigweed, lambsquarters, prickly lettuce, thistles, dandelion | Fully tillered but before boot stage | Requires more restrictive application timing than some herbicides. |
| **Starane Ultra/ Starane Flex** | Wheat, barley, triticale, oats | Mustards, prickly lettuce, kochia, Russian thistle | Three leaf up to flag emergence | Provides good kochia control. |

Weed control in a mixture of several small grains is more complicated than when a single species is grown because some herbicides may not be labeled for specific small grain species, or they may have different restrictions (e.g., plant back, feeding, grazing, etc.) or application methods for different species. Thus, it is important to look for information on the label referring to all the small grain species in a mix to ensure proper herbicide use. Further, herbicide will be extremely limited if legumes are added to small grain forage mixes.

**Figure 11.** Barley Yellow Dwarf Virus Symptoms

## 3. Diseases

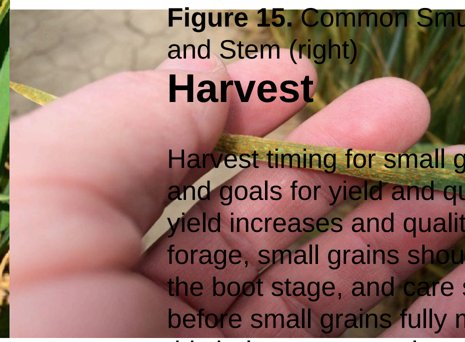
Aphids can transmit **barley yellow dwarf virus (BYDV)** to wheat, oats, and barley as well as wild grass species. Symptoms are usually visible at the jointing stage and can be mistaken for nutrient deficiency or symptoms of other viruses, such as wheat mosaic virus. Initially, the virus causes yellow or red leaf tips. Eventually, the entire leaf can turn yellow, and leaves and roots become stunted (Figure 11). There are two aphid species that can transmit the virus in Utah: English grain aphid (Sitobion avenae) and bird cherry-oat aphid (Rhopalosiphum padi). Management is difficult, and once a plant is infected, there is no cure. Spread of the disease within a field could be minimized by early insecticide applications against aphids.

**Wheat mosaic virus** is occasionally a problem in Utah wheat production. The virus is transmitted to wheat by the wheat curl mite (Aceria tosichella) (Figure 12). The mites are very small and cannot be seen with the naked eye. In addition to wheat, the virus also infects corn, barley, and other grasses. Symptoms on wheat leaves range from green and yellow stripes, yellow spots, or green islands. Fields with volunteer wheat or other susceptible grasses providing a green bridge during the winter for the wheat curl mite are more severely affected.

**Figure 12.** Wheat Curl Mite
Photo: Frank Peairs, Colorado State University

**Snow mold** can affect small grains. There are two types of snow mold in Utah: pink snow mold (Microdochium nivale) and gray snow mold (Typhula spp.). Snow molds are soilborne fungi that thrive in cold temperatures under snow (Figure 13). Once the snow melts and temperatures get above 45 °F, snow molds do not form. Typically, snow molds kill leaves but not the crown, and plants usually recover. In severe cases, the crown and the plant will be killed and not recover, leaving very poor stands in the field. This was noticed by authors and farmers in 2023 when there was a lot of snow in wheat fields after the middle of March. Fungicide applications before snowfall can help but may be too costly. Symptoms of snow mold are dead leaves in areas with deep snow (Frank, 2008). By contrast, plants with winter injury mostly occur in areas with no snow cover or areas with ice cover. Immediately after snowmelt, mycelium (fungal hyphae) covering the plants and/or irregular shaped black (Typhula) or red (Microdochium) sclerotia (round fruiting structures) may be observed. Plants often recover and produce reduced yields if the weather warms up quickly after snowmelt. Stands may be sparser, thereby increasing weed competition. Rotating small grains with legumes can be beneficial for reducing mold. Time fertilizer applications to get good root and crown development. However, avoid dense foliage as it makes the plants more susceptible. Although fall applications of fungicide are effective, they may not be economically feasible, and it is difficult to know in the fall if you will have a problem with mold in the late winter. To learn more about managing snow mold, see these two USU fact sheets: “Snow Mold on Small Grains” and “Speeding Snowmelt to Reduce Snow Mold.”

**Figure 13.** Snow Mold



Symptoms

**Figure 14.** Wheat Strip Rust Symptoms

**Wheat stripe rust** is caused by the fungus Puccinia striiformis. This rust is most active at air temperatures between 50 °F and 60 °F under wet conditions. At temperatures above 77 °F the fungus stops producing spores, and above 85 °F, it dies. Water from irrigation, rain, or dew on leaves is necessary for the spores to germinate and infect the leaves. When infection occurs, it increases water loss due to a ruptured epidermis over the rust pustules (Figure 14). It also reduces photosynthesis and can lead to fewer kernels with lower weight. During mild winters, the rust can survive in plant tissue at temperatures of 23 °F for several days. Survival is mainly in volunteer wheat and from early infections of winter wheat the previous fall. Scouting for rust should start in late March. Fungicides containing propiconazole, azoxystrobin, pyraclostrobin and trifloxystrobin/propiconazole can be used for stripe rust control. Learn more about wheat stripe rust in this USU fact sheet.

**Common smut** is a fungal disease that affects small grains like wheat, barley, and oats. It causes dark, powdery masses of fungal spores, often called smut balls or sori, which can usually be easily detected in the field (Figure 15). Detection typically occurs at small grain heading, when the heads with smut are clearly visible and lack normal grain. Management of smut includes planting resistant varieties where available, using certified disease-free seed, and treating seed with fungicides where needed to prevent infection. Crop rotation can also help reduce disease pressure. Some of the common active ingredients of fungicides applied to seed to control smut include carboxin, tebuconazole, thiram, fludioxonil, and triadimenol.

**Figure 15.** Common Smut Infection of Head of Grain (left) and Stem (right)

## Harvest

Harvest timing for small grains depends on crop purpose and goals for yield and quality. As the plant matures, yield increases and quality decreases. For high-quality forage, small grains should typically be harvested around the boot stage, and care should also be taken to harvest before small grains fully mature. By harvesting early, this helps prevent volunteer plants in successive crops (Hofman, 2018). If high yields are desired, small grains should typically be harvested during the late dough stage. As discussed previously in the "Species and Variety Selection" section, it is also important to harvest before awns develop on awned varieties if the forage will be baled or grazed.

*Small grain mixes have advantages over single species because each species matures at a different rate, and it often allows for a better balance of high forage quality and yield.*

Few trials in this region have been conducted evaluating harvest timing impacts on small grain forage yield and quality. Data from trials in Minnesota demonstrate how yield increases and crude protein decreases for several species as plants mature (Figures 16 and 17). It is important to note that this research was conducted in Minnesota and not the Intermountain West, which has a much drier climate and different soil characteristics that can be limiting for crop growth. The values for crop yield and quality may differ in this region, but the crop stages are the same and will likely follow the same trends for yield and quality regardless of location. There is little research, however, about how harvest timing compares for a single species versus a mix of multiple small grain species. It is important to evaluate the growth stages for all the species in the mix and their benefits, and the best practice may be to optimize harvest timing for the predominant species in the mix. Other factors to consider include environmental conditions, water availability, and each individual operation's management strategies.

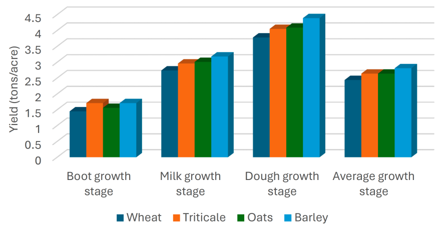



**Figure 16**. *Field of Four Spring Small Grain Species When Harvested at Four Growth Stages*
Data source: Figure is based on adapted data from University of Minnesota Extension (2018)

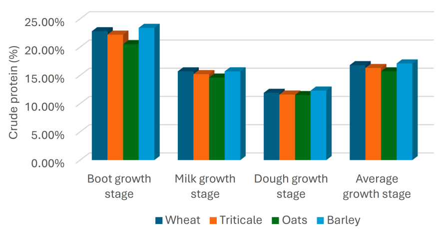



**Figure 17.** *Crude Protein Concentration of Four Spring Small Grain Species When Harvested at Four Growth Stages*
Data source: Figure is based on adapted data from University of Minnesota Extension (2018)

Small grains are often used for silage or baled hay. When harvesting small grains for silage, the maturity stage and moisture content can impact forage quality. Silage quality is usually greatest when harvest occurs at the boot to milk stage. When harvesting for silage, the forages should be raked and chopped near 65%–70% moisture (Teutsch et al., 2025). Once chopped, the silage should be stored properly to prevent spoilage (Hofman, 2018). When swathing/cutting, the forage should be cut as low to the ground as possible to allow the plants to retain the energy stored in the base of their stems. When small grains are harvested for hay, raking at 50% moisture and baling around 14% will help minimize mold and heating within the bales. A single cutting per crop is usually obtained unless forage was cut late enough that adequate seedheads are left in the field, but this is likely not substantial enough for a second harvest. In some areas, it is possible to plant a second small grain forage crop and harvest a second time in a year.

*Small investment in nitrate forage testing are usually well worth the cost.*

Another harvest consideration for small grains is the risk of nitrate poisoning. Plants that experience drought, frost, prolonged hot or cool conditions, or herbicide injury can accumulate excess nitrates. Small grain forage with high nitrate content can be toxic to livestock that consume the feed. There is a higher risk of nitrate poisoning when small grains are harvested at earlier stages, ensiled poorly, or grown in fields where very high rates of manure or fertilizer are applied. An inexpensive and rapid nitrate "QuikTest" can evaluate nitrate levels in forage to ensure feed safety (Yost et al., 2022). This is a routine test at several public and private laboratories. This risk can also be reduced by not over-applying nitrogen fertilizer, waiting several days to graze or harvest when it has been cool and overcast, and ensiling the forage with high nitrate levels. If the small grain forage is grown for hay, nitrate concentrations cannot be lowered after harvest (Collar et al., 2006). Small grain forage with high nitrate concentrations can be diluted by adding in other forage with low nitrates. Use careful monitoring when feeding small grain forage with high nitrate concentrations to ensure they are safe for livestock.

## Small Grain Forage Yield and Forage Quality in Utah

USU has conducted several on-farm research trials in small grains grown for forage (Figure 18). These trials were located across Utah and the species, seeding rates, and planting dates all varied. The results of these trials are summarized in Table 5. When multiple sites had the same small grain forage species planting in the same season (fall vs. spring), the average values across sites for yield and several forage quality parameters are shown. These sites vary widely in precipitation, elevation, and growing season. This makes it difficult to use these numbers to directly compare results, but it offers a starting point for quantifying the yield and forage quality potential of different single and mixed species options for small grain forages.

**Table 5.**
*Summary of Average Yield and Forage Quality of Various On-Farm Small Grain Research Trials Across Utah From 2018–2023*

| Spec | Time | Num of site year | Yield | CP | ADF | NDF | TDN | RFV | RFQ |
|---|---|---|---|---|---|---|---|---|---|
| **Barley (B)** | Spring | 1 | 4.2 | 12.1 | 34.9 | 61.9 | 62.8 | 93 | 46 |
| **Oat (O)** | Spring | 2 | 2.2 | 15.1 | 31.3 | 60.4 | 66.9 | 100 | 74 |
| **Triticale (T)** | Fall | 4 | 3.4 | 11.9 | 36.4 | 64.2 | 61.1 | 88 | 59 |
| **Wheat (W)** | Fall | 2 | 5.4 | 9.5 | 32.7 | 56.8 | 65.3 | 104 | 39 |
| **TW** | Fall | 1 | 3.5 | 14.5 | 32.6 | 61.6 | 65.4 | 96 | 69 |
| **TWB** | Fall | 1 | 2.1 | 18.2 | 29.6 | 59.9 | 68.8 | 103 | 95 |
| **TWW** | Fall | 1 | 3.5 | 16.0 | 32.3 | 59.3 | 65.8 | 100 | 75 |
| **WBO** | Fall | 1 | 3.8 | 12.1 | 33.3 | 56.8 | 62.5 | 138 | 144 |
| **WBO** | Spring | 3 | 3.6 | 12.6 | 33.1 | 61.3 | 64.8 | 96 | 67 |
| **WBOT** | Spring | 2 | 2.9 | 14.8 | 29.8 | 57.4 | 64.2 | 124 | 107 |
| **WBOT and peas** | Fall | 3 | 3.6 | 10.8 | 32.9 | 59.5 | 63.2 | 109 | 70 |

*Notes.* CP = crude protein; ADF = acid detergent fiber; NDF = neutral detergent fiber; TDN = total digestible nutrients; RFV = relative feed value; RFQ = relative feed quality

**Figure 18.**
Harvesting Small Grain Forage Research Plots in Utah

In addition to the trials spread throughout Utah, a set of small grain forage trials were conducted in 2002 at a site near Delta, Utah (Table 6) and in 2005 at a site near Morgan, Utah (Table 7). In these trials, 30 and 18 small grain species and cultivars for Delta and Morgan, respectively, were grown side-by-side in replicated plots to evaluate how their yield and forage quality compare. In the 2002 trial, all species were planted in March and harvested in June at the early heading stage. The soil was an Anco silty clay loam, and the site was flood irrigated. Results from this trial showed that the greatest forage yields were obtained with several oat and two- or six-row barley cultivars. Some of the triticale and wheat cultivars had among the greatest crude protein concentrations.

The trial in 2005 near Morgan was also seeded in the spring (April 12) and harvested in late June to early July for the boot stage yields and Mid-July to early August for soft dough stage yields. The trial was on a site with Canburn silt loam soil. This trial again showed that several oat and six-row barley cultivars had the greatest yield when harvested at the boot stage. When harvest was delayed until the soft dough stage, all the six-row barley cultivars and two of the triticale cultivars had the greatest forage yield. The results from these two trials highlight some of the tradeoffs in forage yield, quality, and harvest timing that were discussed in other parts Figure 18. Harvesting Small Grain Forage Research Plots in Utah 16 of the guide. They also serve as a good reference for the relative performance of several species of small grains grown on the same site.

**Table 6.**

*Small Grain Forage Yield and Forage Quality Results Collected at Early-Heading Stage for 2002 Delta, Utah, Trial, With Results Sorted by Dry Matter (DM) Yield From Greatest to Least*

| Speci | Cultiv | Seedi rate in lb/ acre | Yield in tons DM/ acre | CP | NDF | NDFD 48 hr | IVTDMD 48 hr |
|---|---|---|---|---|---|---|---|
| **Oat** | Magnum 2000 | 91 | 5.47 | 11.2 | 62.4 | 54 | 71.2 |
| **Barley, 6-row** | Steptoe | 110 | 5.30 | 10.9 | 52.6 | 59.6 | 78.8 |
| **Oat** | OSG-FP -1 | 91 | 4.81 | 6.0 | 61.5 | 57 | 73.6 |
| **Barley, 6-row** | Walker | 110 | 4.77 | | | | |
| **Barley, 6-row** | Millenium | 110 | 4.75 | | | | |
| **Barley, 2-row** | Xena | 150 | 4.74 | | | | |
| **Barley, 2-row** | Baronesse | 150 | 4.58 | | | | |
| **Oat** | OSGML-4-1 | 91 | 4.37 | 7.0 | 60 | 56.7 | 74 |
| **Oat** | OSG-CHO-1 | 91 | 4.36 | 7.5 | 63.1 | 59.4 | 74.6 |
| **Triticale** | Trical 2700 | 114 | 4.31 | 12.8 | 57.8 | 70.5 | 83 |
| **Oat** | Otana | 91 | 4.17 | 8.5 | 62.5 | 55.7 | 72.4 |
| **Barley, 6-row** | Westford | 110 | 4.16 | 14.7 | 55.1 | 68.4 | 82.5 |
| **Barley, 2-row** | Haybet | 150 | 4.15 | 11.6 | 57.3 | 61.5 | 78.1 |
| **Oat** | Monida | 91 | 4.15 | | | | |
| **Oat** | Calibre | 91 | 3.95 | | | | |
| **Oat** | OSBGML-4-2 | 91 | 3.84 | 8.7 | 63.5 | 52.2 | 69.7 |
| **Wheat, soft white** | Penawawa | 130 | 3.53 | | | | |
| **Barley, 6-row** | Statehood | 110 | 3.46 | | | | |
| **Oat** | Cayuse | 91 | 3.42 | 5.5 | 61.3 | 51.1 | 70.1 |
| **Wheat, hard red** | Rick | 130 | 3.37 | 14.7 | 55.2 | 66 | 81.3 |
| **Triticale** | Trical 105 | 114 | 3.26 | 14.2 | 54.8 | 70.1 | 83.6 |
| **Wheat, soft white** | Dirkwin | 130 | 3.20 | 16.0 | 52.8 | 70.7 | 84.5 |
| **Triticale** | RSI Castle | 114 | 3.14 | 15.2 | 54.8 | 69.8 | 83.5 |
| **Wheat, soft white** | Twin | 130 | 3.00 | 15.5 | 53.7 | 72 | 84.9 |
| **Oat** | Triple Crown | 91 | 2.73 | | | | |
| **Annual ryegrass, 4n** | Hercules | 30 | 2.14 | | | | |
| **Annual ryegrass, 2n** | Ribeye | 30 | 1.99 | | | | |
| **Annual ryegrass** | Lonestar | 30 | 1.84 | | | | |
| **Annual ryegrass, 4n** | Barmultra | 30 | 1.82 | | | | |

| Speci | Cultiv | Seedi rate in lb/ acre | Yield in tons DM/ acre | CP | NDF | NDFD 48 hr | IVTDMD 48 hr |
|---|---|---|---|---|---|---|---|
| **Annual ryegrass, 2n** | Bartissimo | 30 | 1.00 | | | | |

*Notes*. 2n = diploid; 4n = tetraploid; CP = crude protein; NDF = neutral detergent fiber; NDFD48 = neutral detergent fiber digestibility after 48 hours; IVTDMD48 = invitro true dry matter digestibility after 48 hours. Forage quality was only analyzed for select treatments.

**Table 7.**
*Small Grain Forage Yield and Quality Results for 2005 Trial Near Morgan, Utah, With Results Sorted by Dry Matter (DM) Yield When Harvested at Boot Stage From Greatest to Least*

| Species | Cultivar | Seeding rate in lb/acre | Boot stage yield in tons DM/ acre | Soft dough stage yield in tons DM/ acre |
|---|---|---|---|---|
| **Oat** | EverLeaf 126 | 83 | 3.44 | 5.39 |
| **Barley, 6-row** | Washford* | 125 | 3.38 | 6.62 |
| **Oat** | SW 881529 | 86 | 3.27 | 5.49 |
| **Barley, 6-row** | Goldeneye | 104 | 3.24 | 8.20 |
| **Barley, 6-row** | Sara* | 102 | 3.20 | 6.58 |
| **Oat** | Monida | 84 | 3.09 | 5.50 |
| **Barley, 6-row** | Steptoe | 118 | 2.98 | 7.27 |
| **Wheat, soft white** | Super Dirkwin* | 81 | 2.95 | 4.73 |
| **Barley, 6-row** | Westford* | 103 | 2.93 | 6.77 |
| **Oat** | EverLeaf 114 | 89 | 2.85 | 4.51 |
| **Oat** | Otana | 80 | 2.76 | 5.75 |
| **Triticale** | TRICAL 2700 | 93 | 2.76 | 7.93 |
| **Oat** | Titan | 76 | 2.51 | 4.75 |
| **Barley, 2-row** | Haybet* | 116 | 2.37 | 5.57 |
| **Oat** | Magnum 2000 | 72 | 2.17 | 4.92 |
| **Triticale** | Forerunner* | 139 | 2.10 | 6.06 |
| **Triticale/ wheat mix** | Merlin*/ Super Dirkwin* | 92 | 1.83 | 5.30 |
| **Wheat, soft white** | Twin* | 79 | 1.82 | 4.79 |

## Summary

Small grains provide a valuable option for a high-quality forage crop that can be used in limited-water situations, as a rotational crop, or for grazing animals. They can be grown as individual species or in mixes of multiple small grain species. These mixes are versatile because various species can be chosen to maximize yield and/or forage quality and extend potential grazing periods. It is important to maintain proper irrigation, nutrient, and pest management strategies to ensure crop success. Yield and quality vary greatly depending on the growth stage, so harvest timing and methods vary depending on the intended crop purpose. Small grains can fit well into many management systems and are a great source of high-quality and high-yielding forage.

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