# Selecting Small Grain Cereals for Forage Production

Small cereal crops are a group of forage species used predominantly for grain production, but in the southern United States, they can be used as multipurpose crops for grazing, baleage, and hay production. This group includes barley (*Hordeum vulgare*), cereal rye (*Secale cereale*), oat (*Avena sativa*), triticale (× *Triticosecale* spp.), and wheat (*Triticum aestivum*). One of the advantages of using small grains is that they can be planted in the fall a little earlier than annual ryegrass and can be ready to graze within 45 days under optimum weather conditions. Small grains can lower the need for feeding hay and allow annual ryegrass pastures to develop good amounts of growth before grazing. These species tend to vary in yield due to seasonality, cold tolerance, and recovery (Table 1). It is important to select small grain species that fit under the soil and climatic conditions of your particular area and their intended use (Table 2).

**Table 1. Average biomass production of small grain species as forage crops across four locations in Mississippi. Data collected on oat and rye from 2012 to 2016 and on triticale and wheat during 2012. Source: White et al., 2012–2017.**

| Location[1] | Cereal Rye (lb dm/ac) | Oat (lb dm/ac) | Triticale (lb dm/ac) | Wheat (lb dm/ac) |
|---|---|---|---|---|
| Holly Springs | 2,165 | 2,207 | 2,229 | 1,251 |
| Starkville | 3,082 | 2,694 | 1,783 | 1,765 |
| Newton | -- | 1,344 | 1,022 | -- |
| Poplarville | 4,125 | 4,640 | 2,893 | 4,049 |
| Average | 3,124 | 3,255 | 1,982 | 2,355 |

**[1] Locations are arranged from coldest to warmest during the winter months.**

**Table 2. Estimated comparison of small grain species as forage crops to grazing and environmental conditions.**

| Parameter | Oat | Cereal Rye | Triticale | Wheat |
|---|---|---|---|---|
| Early Grazing Potential | 3 | 4 | 3.5 | 2 |
| Disease Tolerance | 1 | 4 | 4 | 3 |
| Drought Tolerance | 2 | 3.8 | 3.5 | 2.5 |
| Tolerance to Wet Soils | 2 | 3 | 4 | 1.5 |
| Tolerance to Low pH Soils | 2 | 4.5 | 3 | 1.5 |

**Index: 1 = Poor; 2 = Fair; 3 = Good; 4 = Very Good; 5 = Excellent**

# Establishment

There is some benefit to mixing small grain species for grazing purposes, if you do not desire subsequent grain production. Mixing species of cereal rye, wheat, oat, or triticale can help extend the grazing period and reduce the tendency for a strong peak growth period in the spring. Small grains can also be planted in a mixture with clovers and other winter annual grasses, such as annual ryegrass. In this scenario, a two- or three-way mixture can extend the grazing season.

Conventional seeding, no-till, or broadcast methods can be used to establish cereal grains. Recommended seeding rates vary depending on establishment method and seeding combinations (Tables 3a-3c). Small grains should be seeded using a standard grain drill about ½ to 1½ inches deep. Drilling into tilled soil will require 60 to 90 pounds of seed per acre. When no-tilling into an existing sod, rates should be 90 to 110 pounds per acre. When broadcasting or seeding by air, rates as high as 120 pounds per acre may be needed. Seeding date can also have an impact on when small grains can be grazed. If the goal is late-fall grazing, then the seeding of cereal rye, oat, and triticale should be completed by September 15, provided that adequate moisture is available for germination. Wheat does not usually provide much late-fall grazing, and it could be planted between September 15 and October 20. Most of these small grain crops will sustain growth until temperatures drop below 40˚F. When interseeding small grains into established or permanent pastures (bermudagrass or bahiagrass), little fall grazing is expected due to the competition from the existing warm-season sod prior to frost.

# Fertilization

Optimum forage production with small grains can occur when soil pH (acidity) has been corrected and the nutrients are applied at the optimum growth stage. A soil test should be used to determine lime and fertilizer needs. For collecting a soil sample, please contact your local MSU Extension office. The amount of nitrogen (N) applied to small grains will depend on species, soil type, grazing potential, previous fertilization, and planting date. Nitrogen application can increase vegetative growth and can promote tillering. A typical application of nitrogen for small grain forage production should be 30 to 40 units of nitrogen per acre (e.g., 65 to 87 pounds of urea or 91 to 121 pounds of urea ammonium sulfate) in the fall after the stand has germinated and reached at least 2 inches in height. Then, in late winter or early spring, after the first grazing cycle, top-dress with another 30 to 40 units of nitrogen per acre. Phosphorus (P) and potassium (K) can stimulate rapid, early growth, and they can be applied at or before seeding based on soil test recommendations.

**Table 3a. Seeding rates for small grains when planted as a monoculture across two establishment methods.**

| Species | Grown Alone Drilled (lb/ac) | Grown Alone Broadcast (lb/ac) | Mixture Drilled (lb/ac) | Mixture Broadcast (lb/ac) |
|---|---|---|---|---|
| Cereal Rye | 90 | 120 | 60 | 90 |
| Oat | 90 | 120 | 60 | 90 |
| Triticale | 90 | 120 | 60 | 90 |
| Wheat | 90 | 120 | 60 | 90 |

**Table 3b. Seeding rates for small grains when planted as a mixture across two establishment methods.**

| Two-way Grass Mixture | Mixture Drilled (lb/ac) | Mixture Broadcast (lb/ac) |
|---|---|---|
| Cereal Rye + Oat | 45 + 45 | 60 + 60 |
| Cereal Rye + Wheat | 45 + 45 | 60 + 60 |
| Oat + Triticale | 45 + 45 | 60 + 60 |
| Oat + Wheat | 45 + 45 | 60 + 60 |

**Table 3c. Seeding rates for small grains when planted as a mixture across two establishment methods.**

| Three-way Grass Mixture | Mixture Drilled (lb/ac) | Mixture Broadcast (lb/ac) |
|---|---|---|
| Cereal Rye + Oat + Triticale | 30 + 30 + 30 | 40 + 40 + 40 |
| Cereal Rye + Oat + Wheat | 30 + 30 + 30 | 40 + 40 + 40 |
| Cereal Rye + Triticale + Wheat | 30 + 30 + 30 | 40 + 40 + 40 |
| Oat + Triticale + Wheat | 30 + 30 + 30 | 40 + 40 + 40 |

**Note: These mixes are recommended for grass mixes only. If adding annual clovers, then reduce the total mix by 10 to 20 percent, depending on the recommended seeding rate of the clover species.**

## Barley

Barley is the earliest maturing small grain species. This small grain is not as winter-hardy as cereal rye or wheat. It is cold sensitive and will die when temperatures drop below 20˚F. Barley should be planted early (September 1 to September 20) to become well established before frost. It is not commonly grown in the southern United States because it is more susceptible to diseases and pathogens in hot and humid conditions. Barley is adapted to well-drained, loamy soils. It can grow in wet soils, but it does not tolerate waterlogged conditions. Growing barley in sandy soils can cause sporadic plant germination and uneven stands during the growing season. One of the disadvantages of using barley is its lower forage production compared to other small grains, but it has much higher overall forage digestibility.

## Cereal Rye

Cereal rye is more tolerant of cold weather and soil acidity than other small grains. It can be mixed with annual ryegrass to extend the grazing season. Cereal rye has rapid growth in both fall and spring compared to other small grains. It is also the earliest maturing small grain due to its high biomass production in the late fall and early winter. Early maturity could be an advantage when overseeded into warm-season perennial pastures such as bahiagrass (*Paspalum notatum*) and bermudagrass (*Cynodon dactylon*). Cereal rye is more adapted to well-drained soils and lower soil pH than other small grains. It becomes stemmy and unpalatable earlier in the spring compared to the other small grains.

## Oat

The oat crop is generally the most cold-sensitive of the small grain crops; temperatures below 39˚F can greatly reduce forage growth and grazing potential. When planted earlier, oat can provide late fall grazing. Similar to barley, oat should be planted early to avoid cold weather that can impact seedling development. Oat is best adapted to well-drained clay and sandy-loam soils and does not produce optimum growth under extremely dry or wet conditions as compared to wheat or cereal rye. Oat is also more susceptible to leaf rusts than cereal rye or wheat.

## Triticale

Triticale is a cross between wheat and cereal rye. It has characteristics and production very similar to wheat. Triticale does not tiller as much as wheat. This crop will grow on most soil types. It can be planted in lower pH soils than other small grains, and it can perform well in waterlogged conditions. Triticale's stress tolerance and disease resistance are typically greater than wheat's, but it is slightly more susceptible to ergot than wheat.

### Wheat

Wheat is a commonly planted species for grazing. It is less susceptible to cold injury when compared to oat, but both species have very similar forage yield production. Wheat grows at temperatures between 38°F and 77°F. In a forage system, it is recommended to use cultivars (varieties) that are resistant to the Hessian fly (*Mayetiola destructor*). Wheat tends to be more heat sensitive than cereal rye and oat, so it cannot be planted early. This crop provides more forage production in late winter and early spring. Wheat is adapted to moist soils (wet clay soils) but grows best on well-drained, loamy soils. It is less tolerant to poorly drained soils than cereal rye and triticale.

## Forage Quality

Small grains can be very nutritious to livestock in late fall through spring, which allows stocker cattle to have daily body weight gains ranging from 1.5 to 2.5 pounds. Small grains tend to have similar nutritive values when harvested or grazed at equal maturities (Tables 4 and 5). All small grain forages are high in quality and give good animal performance over their growing season, as long as grazing is managed to keep the small grains in the vegetative stage of growth. Like other forage species, the forage quality of small grains is affected by the stage of growth, species, and fertility. Crude protein can range from 18 to 22 percent in the fall, winter, and early spring. It decreases sharply during stem elongation and seed head formation. During the vegetative growth stage, dry matter digestibility can range from 70 to 75 percent. Most of the changes in nutrient composition and forage quality are related to growth stages or changes in maturity. Leaves are most digestible and higher in protein than stems. This causes an inverse relationship. Therefore, as the plant develops, there is a reduction in leaves and a reduction in crude protein and digestibility. The combined effects of changes in leaf to stem ratios alters the nutritional quality of leaves, stems, and seed heads. This results in a steep decline in whole-plant nutritive values as maturity increases. Small grains can maintain excellent digestibility and protein during the early growth stages through the boot stage. Knowing the growth patterns of specific small grain varieties can help livestock producers choose a variety that is not only adapted to the climatic conditions, but that can provide the maximum amount of vegetative growth to extend the grazing season and increase animal performance.

**Table 4. Relative crude protein (CP) differences of small grain species at different growth stages. Adapted from Ditsch and Bitzer, 1995.**

| Growth Stage | Oat (% Dry Matter) | Cereal Rye (% Dry Matter) | Triticale (% Dry Matter) | Wheat (% Dry Matter) |
|---|---|---|---|---|
| Boot | 12 | 13 | 11 | 10 |
| Headed | 10 | 11 | 9 | 10 |
| Bloom | 9 | 9 | 8 | 8 |
| Half Seed | 9 | 7 | 7 | 9 |
| Milk | 8 | 6 | 6 | 7 |
| Soft Dough | 7 | 5 | 5 | 6 |

**Table 5. Relative total digestible nutrient (TDN) differences of small grain species at different growth stages. Adapted from Ditsch and Bitzer, 1995.**

| Growth Stage | Oat (% Dry Matter) | Cereal Rye (% Dry Matter) | Triticale (% Dry Matter) | Wheat (% Dry Matter) |
|---|---|---|---|---|
| Boot | 65 | 63 | 56 | 60 |
| Headed | 60 | 52 | 46 | 59 |
| Bloom | 53 | 46 | 46 | 53 |
| Half Seed | 53 | 45 | 45 | 54 |
| Milk | 56 | 47 | 50 | 56 |
| Soft Dough | 57 | 50 | 52 | 56 |

# Grazing Management

Small grains tend to have the same general pattern of dry matter accumulation as indicated in Table 6. That does not mean that varieties within a specific small grain species will follow that pattern. Varieties can differ in relative yield and quality at different growth stages. This can be influenced by planting date, fertilization, genetics, moisture, temperature, grazing pressure, and rest periods. Weather conditions, fertilization, growth rate and recovery, and stocking rate may dictate when a specific small grain species and variety might be grazed. Small grains should not be grazed until crown roots are fully developed because they are needed to anchor the plants in the soil. To optimize grazing and return in small grain pastures, grazing small grains should be delayed until plants reach 8 to 10 inches of growth and they begin to tiller (about 4 to 6 weeks after emergence) depending on rainfall, fertilization, and temperature. At least 4 inches of residual biomass should remain through the winter to provide enough cover for insulation and recovery. One way to test if the plants are ready for grazing pressure is by mimicking grazing behavior. To do so, hold the plants between your thumb and forefinger, then pull and twist. If the plants stay strong in the ground, then the crop is ready to be grazed. Always adjust the number of animals according to the amount of growth and available biomass. To increase efficiency, subdivide the pastures into smaller paddocks and graze them rotationally.

For small grains that were planted during the recommended window in a prepared seedbed, grazing should be available from mid-November through December and from late January to mid-April. A minimum of 45 to 60 days of forage growth is needed in the fall before sufficient biomass is available for grazing. One acre of small grains that was properly fertilized should be able to support one animal unit (one 1,000-pound animal or two 500-pound animals). Keep in mind that small grain forage production can decrease after the plant apex (growing point) is above the soil surface. During this process, the first node will be visible at the base of the shoot. Although small grains can be continuously grazed, a rotational or strip grazing management system is recommended to increase carrying capacity. Rotational grazing systems promote the recovery of small grains after grazing and aid in pasture growth and recovery. This can be achieved by subdividing pastures into paddocks or using a temporary electric fence.

There is considerable variation in pasture production from year to year and among different varieties of small grain cereals. Stocking rates must be adjusted to match the small grain's production potential. Plan stocking rates that match the season production of the species being used. Small grains usually produce good pasture in late fall and early winter. Production usually declines from early January to mid-February and then resumes, depending on temperature and moisture conditions.

**Table 6. Dry matter (DM) accumulation of small grains at different growth stages. Adapted from Fhoner, 2002.**

| Growth Stage | Leaves (DM % of Total Yield) | Stems (DM % of Total Yield) | Seed Heads (DM % of Total Yield) |
|---|---|---|---|
| Vegetative | 8 | 0 | 0 |
| Late Vegetative | 30 | 4 | 0 |
| Boot | 34 | 18 | 0 |
| Head | 35 | 18 | 8 |
| Flower | 40 | 20 | 10 |
| Dough | 24 | 28 | 38 |
| Mature Seed | 20 | 32 | 48 |

## Summary

Small grains can be very versatile crops and provide an excellent source of forage for stocker cattle. Before selecting a species and variety, it is a good idea to learn about both the positive and negative characteristics of each species. When you select a species, pick one that will fit into your climatic conditions, is adapted to your soil conditions, and fits your intended grazing purpose. Overall, the grain species will not vary considerably in quality, but they do vary in yield. Not all small grain species are equal when it comes to forage production because of differences in seasonality, cold tolerance, and recovery. Maximizing the forage potential of any of these cereal crops depends on several basic production factors. It is important to follow the recommended planting dates for each species. All small grains respond to nitrogen. Adequate fertilizer amounts are required for maximum forage production with small grains.

## References


Bates, G. & Burns, J. (1999). *Small grains, ryegrass, and clovers for forage*. University of Tennessee Cooperative Extension Service Publication SP 434-A.

Beck, P., Gadberry, S., & Jennings, J. (2013). *Using cool-season annual grasses for grazing livestock*. University of Arkansas Cooperative Extension Service Publication FSA-3064.

Biermacher, J. T., Coffey, C., Cook, B., Childs, D., Johnson, J., & Ford, D. (2009). Economic advantage of no-tilling winter forages for stocker grazing. *Journal of the ASFMRA*, 2009, 25–34.

Blount, A. R. & Stanley, R. L. (2017). *Ryegrass, small grains, and tall fescue*. University of Florida Cooperative Extension Service Publication SS-AGR-107.

Buntin, G. D. & Cunfe, B. M. (Eds) (2017). *Southern small grains resource management handbook*. University of Georgia Cooperative Extension Service Publication 1190.

Ditsch, D. C. & Bitzer, M. J. (1995). *Managing small grains for livestock forage*. University of Kentucky Cooperative Extension Service Publication AGR-160.

Edwards, J., Warren, J., & Redfearn, D. (2014). *Sod-seeding small grains into bermudagrass pasture*. Oklahoma State University Cooperative Extension Service Publication PSS-2071.

Fohner, G. (2002, Dec. 11–13). *Harvesting maximum value from small grain cereal forages*. Western Alfalfa and Forage Conference. Spark, NV.

Shroyer, J. P., Bowden, R. L., Lamond, R. E., Staggenborg, S. A., Peterson, D. E., & Thompson, C. R. (1996). *Triticale in Kansas*. Kansas State University Cooperative Extension Service Publication MF-2227.

Watson, S. L., Fjell, D. L., Shroyer, J. P., Bolsen, K., & Duncan, S. (1993). *Small grain cereals for forage*. Kansas State University Cooperative Extension Service Publication MF-1072.

White, J., Lemus, R., Saunders, J. R., Fitzgerald, L., & Johnson, B. (2012). *Mississippi annual cool-season forage crop variety trials, 2011–12*. Information Bulletin 470.

White, J., Lemus, R., Saunders, J. R., Fitzgerald, L., & Johnson, B. (2013). *Mississippi annual cool-season forage crop variety trials, 2012–13*. Information Bulletin 479.

White, J., Lemus, R., Saunders, J. R., Rivera, D., & Johnson, B. (2014). *Mississippi annual cool-season forage crop variety trials, 2013–14*. Information Bulletin 488.

White, J., Lemus, R., Saunders, J. R., Rivera, D., & Johnson, B. (2015). *Mississippi annual cool-season forage crop variety trials, 2014–15*. Information Bulletin 501.

White, J., Lemus, R., Saunders, J. R., Rivera, D., & Rushing, J. B. (2016). *Mississippi annual cool-season forage crop variety trials, 2015–16*. Information Bulletin 512.

White, J., Lemus, R., Saunders, J. R., Rivera, D., & Rushing, J. B. (2017). *Mississippi annual cool-season forage crop variety trials, 2016–17*. Information Bulletin 522.

**Publication 3165** (POD-03-24)

By **Rocky Lemus**, PhD, Extension/Research Professor, Plant and Soil Sciences.

MISSISSIPPI STATE UNIVERSITY EXTENSION

Copyright 2024 by Mississippi State University. All rights reserved. This publication may be copied and distributed without alteration for nonprofit educational purposes provided that credit is given to the Mississippi State University Extension Service.

Produced by Agricultural Communications.

Mississippi State University is an equal opportunity institution. Discrimination in university employment, programs, or activities based on race, color, ethnicity, sex, pregnancy, religion, national origin, disability, age, sexual orientation, gender identity, genetic information, status as a U.S. veteran, or any other status protected by applicable law is prohibited.

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. ANGUS L. CATCHOT JR., Director