



Crop Science Report

RESEARCH/EXTENSION

GROWING CEREAL GRAINS FOR FORAGE

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INTRODUCTION

Cereal crops are important sources of forage. They are useful in providing forage in critical situations of forage shortage or when soil or climate may limit use of other forage crops.

AREA OF ADAPTATION

Cereal grains are suited to a wide range of soils and cropping conditions, but vary somewhat in their soil suitability and preference. Winter rye (*Secale* spp.), and wheat (*Triticum* spp.) will produce best when grown on fertile, well drained soils of medium or heavier texture, and are more productive than other small grains on soils which are more acid and less fertile, higher in clay or sand content, or more poorly drained. Winter wheat is generally more winter-hardy than winter barley (*Hordeum* spp.), which is more hardy than winter oats (*Avena* spp.). Winter rye can survive lower temperatures than other small grains.

Some spring barley varieties mature in about two months, and earlier than spring rye, wheat, or oats. Barley is sensitive to poorly drained soil conditions, (but more tolerant than wheat) grows better in dry than moist hot climates, and can tolerate moderate droughts. Barley can tolerate more salinity but less acidity than other cereals.

Oats grow best in cool moist climates and are more tolerant of wet soil conditions than barley. They require more moisture than other small grains and tolerate a wider acid soil pH range and finer soil texture than wheat or barley.

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Primary Uses

Cereal grains can be used for grain production, hay, silage, or grazing. The area devoted to forage production fluctuates with time, as feed and market situations dictate.

Oats sometimes are used as a companion crop with alfalfa at the time of establishment. Although not generally recommended in Oregon, oats planted with a new seeding of alfalfa can provide protection against the drying and erosive effects of strong winds and protection against frosts. Adequate water during the early stages of growth is essential for good growth. Harvested in the soft dough stage this crop can be used for green chop, silage, or hay.

Barley can be used as a reclamation crop due to its high tolerance of high pH and saline soils. Following barley, other less saline tolerant crops can then be used.

Grazing of small grains is practiced in many areas when livestock are a part of the farm enterprise and growing conditions permit.

The best choice of a small grain for forage depends on the cropping system and the time of seeding. Smooth awned or awnless varieties are preferred since rough awns can seriously irritate livestock mouths. Barley or oats may be preferred for an early fall seeding following corn harvested for silage. Later plantings of wheat or rye may be used because of their greater winter hardiness.

Since there is a better market for grain of wheat, oats, or barley than rye, their use provides greater flexibility. In a multiple cropping system, using cereal grains for silage, the earlier maturity of barley over that of wheat will result in less delay in planting summer annual grasses or corn.

Wheat yields as much forage as rye or barley, more than oats, and is higher in quality than rye. Rye grows better at low temperatures but becomes stemmy and fibrous earlier in spring.

Oats are the most palatable of the cereals grown for forage, followed by wheat and barley and then rye. Oats are often preferred because the fine stems lead to easy curing and high palatability.

ESTABLISHMENT

Forage production is influenced by species, varieties, seeding rate, temperature, soil fertility, and management. When planting cereal grains for forage production seeding rates often are increased by 50 to 100 percent over rates used for grain production (Table 1). The hay is finer stemmed at higher seeding rates, but there is increased danger of lodging. Heavier seeding rates in early seedings favor higher autumn production while lower seeding rates encourage tillering.

Table 1. Seeding rates of cereal grains when used for grain and forage.

Precipitation (inches)	Cereal Seeding Rate	Cereal Seeding Rate
	Grain (lbs/A)	Forage (lbs/A)
Greater than 40 or Irrigated	100	150
20 to 40	80	120
less than 20	60	100

FERTILIZATION AND pH REQUIREMENTS

The amount of fertilizer nitrogen (N) used on small grains influences yield greatly, although phosphorus (P) and potassium (K) also are important. Since large amounts of N increase the danger of lodging, more N can be used when the stand is to be used for grazing, hay, or silage, than when it is to be harvested for grain. In areas of abundant rainfall N, P, and K are applied at planting time, and additional N is topdressed in winter and/or spring. When grain is to be harvested after grazing, additional N (30 to 40 pounds) may be needed.

Generally, small grains tolerate moderate salinity or pH as low as 5 to 5.5. Barley can tolerate more salinity but less acidity than other cereals.

Consult OSU Fertilizer Guide 9 for specific recommendations based upon soil test data.

YIELD POTENTIAL

Silage yields of 12 to 14 tons per acre (70% moisture) have been harvested from fall-planted cereals with 20 pounds of N at seeding and 110 pounds of N applied in March. This is double the yield obtained when N was not applied. Triticale (a wheat-rye hybrid derivative), rye, and wheat have been shown to yield significantly more forage than oats or barley (Tables 2 and 3).

Table 2. Yield of various small grains seeded in mid-October in Corvallis.¹

Variety	Tons per Acre (70% Moisture Silage)
Abruzzi Rye	14.7
VT 75-229 Triticale	12.6
Sel N-91 Triticale	12.4
S-72 Triticale	11.3
Kung Rye	10.5
Adair Barley	10.4
Yamhill Wheat	9.7
Stephens Wheat	9.7
Amity Oats	8.7
Grey Winter Oats	7.9
Casbon Barley	7.6
FB 73130 Barley	7.6

¹Ben-Ali, Mohamed N. 1980. Yield and quality of cereals for winter silage production. M.S. Thesis. Oregon State Univ.

Table 3. Yield of various small grain and small grain-winter pea combinations grown in Corvallis.[¶]

Variety	Tons per Acre (70 % Moisture Silage)
Rye, Kung	16.5
Wheat, Yamhill	15.8
Wheat, Yamhill and Peas, Austrian Winter	14.0
Wheat, Yamhill and DeKalb Forage mixture	13.5
Triticale, N-91	13.1
Oats, Gray Winter and Peas, Austrian Winter	13.0
Wheat, Yamhill and Oats, Gray Winter and Barley, Casbon	12.7
Oats, Gray Winter	12.2

[¶] Lowrie, D., D. Claypool, and L. R. Vough. Unpublished Data.

HARVESTING CEREALS FOR HAY OR SILAGE

Small grains, with or without a legume, can be harvested as silage or green chop and used with excellent results. The stage of harvest is critical in determining feeding value. Total dry matter production of oats increases rapidly up through the milk stage, but very slowly or not at all from soft dough to maturity (Table 4). Highest digestibility of oats is attained in boot and early head stages, decreasing thereafter more rapidly than in wheat and barley. Therefore, wheat and barley can be cut sometime between the boot and soft dough stages, but oats should be cut in boot to early head.

Rye should be cut at the boot stage or earlier. Generally, rye and triticale are ready to cut first, followed by barley, then wheat, and finally oats. In Western Oregon, rye and triticale may mature too early in the spring (early May) to allow harvesting at a stage of maturity most desirable for high feed value.

The wilting of small grains cut in the boot stage of 60 to 70 percent moisture is desirable to prevent seepage loss from silos and undesirable odors in the silage. Wilting to 70 percent moisture may be difficult, however, in early spring in Western Oregon. Wheat and barley harvested in the soft dough stage contain 65 to 70 percent moisture and can be ensiled directly without seepage loss.

Oats or barley make better hay than wheat, though barley hay may sometimes be objectionable because of the beards. Rye hay is the least desirable, as it is coarse and lacks palatability.

Small grains grown alone are easier to cut and will cure more quickly than when grown with a legume. A mixture of oats and peas, however, is sometimes preferred to oats alone for hay. The peas increase the palatability and the protein concentration of the hay. Winter vetch seeded with small grains will increase the protein content

of the feed but not often the total dry matter production. Since protein content of vegetative small grains is rarely less than 14 to 16 percent and often much higher, the addition of a legume to a small grain pasture may not be necessary to meet the nutritional needs of grazing livestock.

NUTRITIVE VALUE OF SMALL GRAIN SILAGE

The nutritive value and yield of small grains grown for silage varies greatly with stage of maturity (Table 4). As with other forages, the crude protein (CP) concentration decreases as plants mature. Total digestible nutrients (TDN) increase, however, as small grains develop toward mature grain. The best compromise of yield, CP and TDN is the milk or early dough stage of maturity.

Table 4. Moisture, crude protein (CP), total digestible nutrients (TDN), and relative yield of oat silage as affected by stage of maturity.

Stage of Maturity	Percent Moisture	CP 100% DM	TDN 100% DM	Relative Yield 68% Moisture
Vegetative	86	23	76	25
Boot	85	22	72	30
Heading	82	15	68	45
Milk	78	12	64	65
Early Dough	71	10	62	90
Late Dough	68	9	59	100

Nutritive value also varies with small grain species harvested for silage at the early dough stage of maturity (Table 5).

Table 5. Crude protein (CP), total digestible nutrients (TDN), calcium (Ca), and phosphorus (P) concentrations of various silages harvested at a late dough stage of maturity. Values are expressed as percent dry matter.

Type of Silage	CP	TDN	Ca	P
Corn	8.3	64	0.33	0.23
Oat	8.9	59	0.47	0.33
Barley	10.4	49	0.41	0.26
Wheat	8.7	64	0.44	0.26
Rye	11.6	49	0.39	0.32

Nutritive values for small grain hay and straw and comparative values for other hay crops is provided in Table 6.

Table 6. Crude protein (CP), total digestible nutrients (TDN), calcium (Ca), and phosphorus (P) values of various hay and straw crops.

Type of Hay or Straw	CP	TDN	Ca	P
Wheat Hay	7.5	66	0.14	0.18
Wheat Straw	3.6	48	0.17	0.08
Barley Hay	8.9	57	0.21	0.31
Barley Straw	4.1	41	0.34	0.09
Oat Hay	9.2	61	0.26	0.24
Oat Straw	4.4	52	0.33	0.10
Rye Hay	7.3	45	0.35	0.28
Rye Straw	3.1	31	0.28	0.10
Timothy Hay (mid-bloom)	8.5	61	0.41	0.19
Orchardgrass Hay	9.7	57	0.45	0.37
Alfalfa Hay (early bloom)	18.4	58	1.25	0.23

GRAZING MANAGEMENT

Grazing management depends on whether the crop is to be used entirely for pasture, or if hay, silage, or grain also is to be harvested. Heavy fall grazing (1 to 2 inches) of early planted cereals increases the danger of winter-killing by weakening the plant and decreasing the photosynthetic area needed for vegetative regrowth.

Moderate fall and winter grazing (4 to 6 inches) has little deleterious effect on subsequent grain yields; sometimes it may prevent lodging and increase tillering and grain yields. Heavy or late spring grazing (grazing which removes the reproductive heads) seriously reduces grain production. To avoid grain yield reductions, animals should be removed from the pasture when the floral parts are $2\frac{1}{2}$ inches above the soil surface.

In Western Oregon, spring type grains (wheat, barley, oats) may be sown in fall to increase grazing forage during fall and winter. Spring types grow much more rapidly in cool weather than do winter types but they are subject to winter kill if temperatures fall below 10° F.

Off-flavor milk is sometimes produced by cows pasturing small grains, especially rye, in the spring. The problem can be alleviated by changing the animals from winter feed to pasture gradually and removing them from the pasture a few hours before milking.

Adapted from:

Fribourg, Henry A. 1973. Summer Annual Grasses and Cereals for Forage. In Heath, M.E., D.S. Metcalfe, and R.F. Barnes (Eds). Forages. Third Ed. Iowa State Press.

Jurgens, Marshall H. 1978. Animal Feeding and Nutrition. 4th Ed. Kendall/Hunt Pub. Co., Dubuque, Iowa.

National Academy of Sciences. 1971. Atlas of Nutritional Data on United States and Canadian Feeds. Subcom. Feed Comp., Comm. on Anim. Nutr., Agric. Board, Nat. Res. Coun. US., and Comm. Feed Comp., Res. Branch, Dept. of Agric., Canada., Wash. D.C.