USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

Guidelines for Growing Perennial Cool-Season Grasses

U.S. Dairy Forage Research Center

Introduction

From an agronomic perspective, there are many advantages associated with growing perennial cool-season grasses, including:

- adaptability to a wide range of soils
- fewer problems with pests and winterkill compared to alfalfa
- shorter wilting/drying times after mowing/conditioning compared to alfalfa or other forages
- strong responsiveness to nitrogen (N) fertilization
- additional and flexible management options for dairy producers growing their own feed when applying manure and managing manure nutrients.

The objective of this outreach publication is to provide some guidelines and suggestions for varietal selection, establishment, and harvest management to support improved producer success.

Variety Selection

Generally, perennial cool-season grass varieties should be selected with as much scrutiny as corn or alfalfa varieties. Planting whatever the local feed mill has in stock is a very questionable practice. Choosing seed with a named variety as opposed to 'variety not stated' (vns) on the label is strongly advised to take advantage of recent genetic improvements. Dr. Dan Undersander, University of Wisconsin Extension Forage Specialist (now retired), suggested five criteria for selecting an appropriate perennial cool-season grass variety (Undersander, 2017). These included selecting or strongly considering:

- high yielding varieties, with a seasonal yield goal of at least 4 tons of dry matter (DM)/acre
- varieties tested for winterhardiness to ensure suitability/survival of a particular variety for the climatic norms of a specific area
- medium- to late-maturing varieties, which will maximize flexibility for the initial harvest
- varieties with more consistent seasonal yield distribution, thereby avoiding those with disproportionately greater yield during the first cutting
- orchardgrass, tall fescue, and meadow fescue varieties with rust resistance; rust can reduce yield, and may affect forage quality, preference, and intake by livestock

A producer may wonder where this type of unbiased information might be obtained. One good source, based on University of Wisconsin Field Trials conducted since 1996 can be reviewed at https://fyi.extension.wisc.edu/forage/comparison-of-cool-season-grasses-by-harvested-yield-2/. Similar types of information from Cornell University can be found at https://blogs.cornell.edu/varietytrials/forage/. Other state extension services may provide similar information for varieties best adapted to specific regional climatic conditions. For example, see: https://extension.psu.edu/forage-variety-trials-reports or https://forage.msu.edu/publications/.

An abbreviated example of seasonal yield distribution for selected orchardgrass varieties is summarized in Table 1. Data are compiled from the University of Wisconsin Field Trials mentioned previously. Data within the table show that a simple consideration of total annual yield masks numerous other considerations specifically mentioned by Undersander (2017), such as maturity rating and yield distribution. Other relevant data applicable to

Table 1. Seasonal yield distribution of selected orchardgrass varieties, ranked by total annual yield (Source: University of Wisconsin Extension[1]).

Variety	Maturity	Annual Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Winter Survival[2]
		tons DM/acre	-----------------		*% of total yield*			-----------------	
Pizza	medium-late	7.7	25	17	18	14	17	8	2
Valliant	Late	6.9	9	12	24	17	21	17	3
Bronc	Medium	6.5	40	29	19	12	. . .	. . .	2
Benchmark	Early	6.0	35	25	23	18	. . .	. . .	2
Olympia	medium-late	5.4	23	11	18	15	18	15	2
Warrior	Early	5.0	32	26	25	18	. . .	. . .	1

[1] https://fyi.extension.wisc.edu/forage/comparison-of-cool-season-grasses-by-harvested-yield-2/
[2] *Winter Survival Ratings: 1 = superior, 2 = good, 3 = average, 4 = poor, and 5 = none.*

varietal selection, such as rust resistance and winter survivability ratings also may be available.

As a simple contrast, consider the yield distributions of the Valliant and Bronc orchardgrass varieties in Table 1, which exhibited similar respective annual yields (6.9 and 6.5 tons DM/acre). However, the annual yield for Valliant is well distributed, with a minimal percentage associated with the Cut 1 (9%), while Bronc has a disproportionate percentage of total yield associated with first cut (40%).

The early maturation of orchardgrass has been viewed historically as problematic with respect to harvest timing. Therefore, varieties should be selected with care, weighing the various traits (both strengths and weaknesses) to the producer's best advantage. In many situations, later-maturing cultivars provide more flexibility with respect to avoiding uncooperative spring weather conditions during harvest. Later-maturing varieties also may improve flexibility and compatibility in completing other cropping requirements, such as planting corn, or harvesting a first cutting of alfalfa. Depending on the maturity, a two-week difference in heading date can occur. Whenever possible, it is advised to take advantage of this type of information when making varietal selections. Since perennial forages are expected to last for multiple growing seasons, this helps to avoid considering purchase cost alone, which is a practice that may provide immediate monetary savings but is foolish when considered within the context of potential long-term benefits.

Establishment

Obtaining a soil test and following soil-test recommendations are always advisable for successful establishment of new cool-season grass stands. In addition, many seedings fail because of loose or cloddy soil that causes poor soil-seed contact. As such, care should be taken to ensure a firm seedbed, which may include use of a roller or corrugated cultipacker follow seedings on tilled sites.

Seeding-rate recommendations are often documented by university Extension services, but they may vary somewhat between states or regions. Seeding rates also will vary depending on whether grasses are to be planted as mixtures or in a monoculture, as well as whether they are to be drilled or broadcast seeded (Table 2). More persistent grasses may be sown with less persistent grasses for faster cover and improved yield during the seeding year. For example, tall fescue or orchardgrass can be planted at 10 lbs/acre with Italian ryegrass or festulolium included at a lower rate of 2 lbs/acre.

Appropriate seeding dates for perennial cool-season grasses will vary regionally based on expected climatic norms; consult your state Extension service for recommendations specific to your location. For example, perennial cool-season grasses should be established in the north-central US during the spring (April to May) or summer (July to August). Seeds should be placed into a firm, well-prepared seedbed at a depth of ¼ to ¾ inches, depending on seed size. Seedings can be unsatisfactory if seeds are placed too deep in the soil, or if seeds are placed at inconsistent depths throughout the field. In Wisconsin, yields in the

Table 2. Seeding rates for various perennial cool-season grasses summarized from various state extension services and other sources[1].

	------- Wisconsin --------		------ Missouri ------			
Species	**Monoculture**	**Mixture**	**Broadcast**	**Drilled**	**Michigan**	**Southern US**
	lbs pure live seed/acre[2]					
Bluegrass	15	. . .	10 to 15	8 to 10	8 to 10	10 to 15
Smooth bromegrass	16	3 to 6	15 to 20	10 to 15	12 to 15	15 to 20
Meadow bromegrass	. . .	. . .	. . .	. . .	15 to 20	. . .
Meadow fescue	15	6	. . .	. . .	15 to 20	. . .
Tall fescue	15	6	15 to 20	10 to 15	12 to 15	15 to 20[3]
Orchardgrass	10	2 to 4	--------- 10 to 15 ---------		10 to 12	15 to 20
Perennial ryegrass	20-25	2	15 to 30	15 to 20	20 to 30	14 to 18[4]
Reed canarygrass	6	5	5 to 10		6 to 8	5 to 8
Timothy	8	2 to 4	8	3 to 6	6 to 8	6 to 8
Festulolium	. . .	. . .	. . .	. . .	20 to 30	. . .

[1] Sources: Roberts and Gerrish, 2001; Ball et al., 2015; Cassida and Kaatz, 2019; UW Extension Forage Team (date unstated).
[2] Pure live seed clearly stated for Wisconsin, Missouri, and Michigan, and assumed for Southern US.
[3] When broadcast seeded, 20 to 25 lbs/acre.
[4] For mixtures, 5 to 8 lbs/acre.

spring following a late-summer establishment will likely be reduced if seeding is delayed beyond late August (Undersander, date unstated).

Nitrogen fertilizer can be applied at a rate of 30 to 40 lbs N/acre when seedlings are 4 to 6 inches tall to aid growth and establishment. Broadleaf weeds can be controlled with recommended herbicides, while annual grasses can be controlled with frequent clipping throughout the establishment year.

Harvest Management

When harvesting grass for hay or silage, cutting height is a major consideration. Unlike alfalfa, most perennial cool-season grasses store their growth reserves in tiller or stem bases. While a closer cut may result in greater yields (at least initially), this practice also may have negative effects on long-term persistence.

To examine these management considerations, different cutting protocols were evaluated in a two-year study conducted at Marshfield and Lancaster, Wisconsin (Brink et al., 2010). Management treatments imposed for this study were intended to simulate cutting frequency and stubble heights consistent with conservation as hay or silage, rather than as a managed grazing system. Figure 1 summarizes overall mean annual yields for tall fescue, orchardgrass, and meadow fescue grass cultivars cut every 40 to 65 days (3 harvests/year) leaving either 2- or 4-inch residual stubble heights.

Dry matter yields were greater with the shorter (2-inch) clipping height in both years that immediately followed establishment. However, these responses masked other important trends. Both tall fescue and orchardgrass cultivars exhibited greater yields during the second year of the experiment, while the meadow fescue cultivars declined under identical management practices. This suggests a potential yield reduction over time for this forage type, but longer-term experiments are needed to better understand if this response can be definitively confirmed.

Secondly, DM yields from meadow fescue cultivars were more competitive with tall fescue and orchardgrass at the Marshfield research site, which is located in central Wisconsin (north of Lancaster). This response can possibly be attributed to meadow fescue's adaptation to colder climates, as it represents a major component of Nordic and Baltic grasslands.

Despite the short-term yield advantage associated with a shorter (2-inch) cutting height, there was evidence of lost ground cover associated with the shorter clipping height for all forages evaluated (see Figure 2). However, tall fescue was the most resilient to the clipping treatments evaluated in this study, maintaining the greatest percentage of

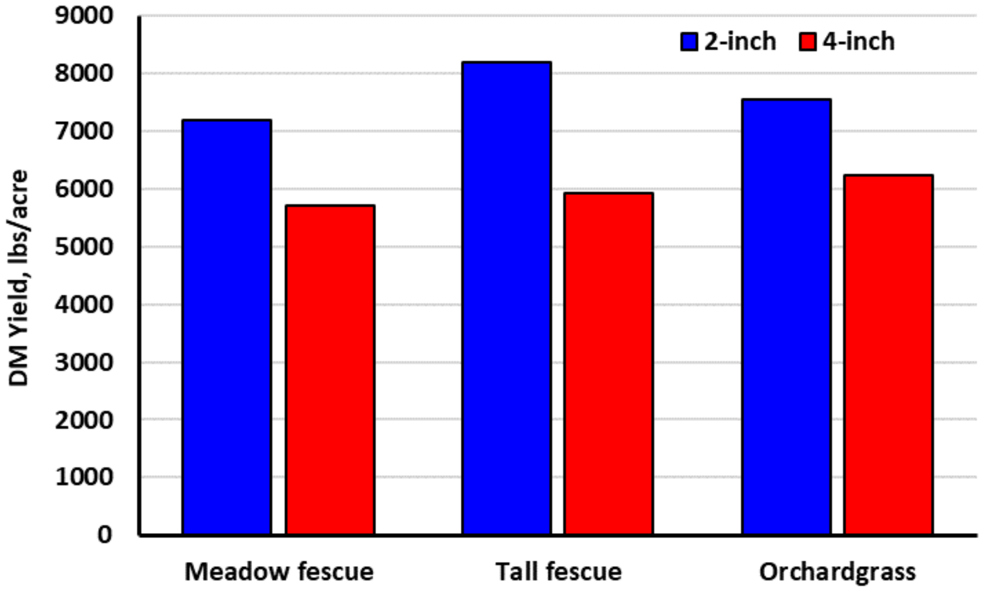

Figure 1. Two-year mean yield responses for three meadow fescue, one tall fescue, and one orchardgrass cultivar clipped three times per year at 2- or 4-inch residual stubble heights near Marshfield and Lancaster, Wisconsin [adapted from Brink et al. (2010)].

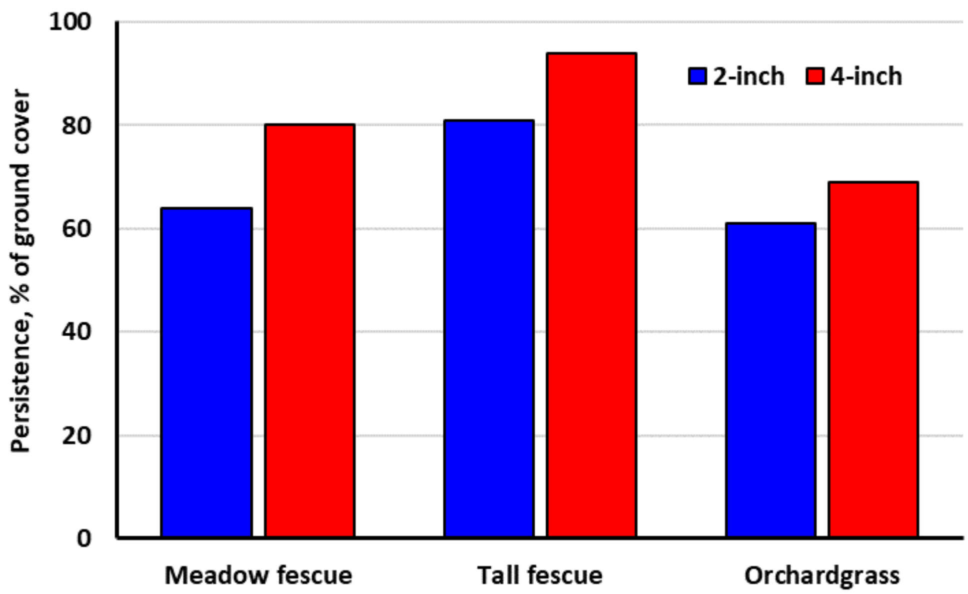

Figure 2. Persistence (% of ground cover) after two years of imposed treatments for three meadow fescue, one tall fescue, and one orchardgrass cultivar clipped three times per year at 2- or 4-inch residual stubble heights near Marshfield and Lancaster, WI [adapted from Brink et al. (2010)].

ground cover. After 2 years of defoliation, only a small decrease (13 percentage units) in ground cover (93 to 80%) was observed for this forage species in comparisons between the 4- and 2-inch clipping heights. Both meadow fescue and orchardgrass exhibited poorer ground cover than tall fescue, and both forages also were affected negatively by the shorter clipping height. After two years, the mean percentage of ground cover for all forage species was 81% at the 4-inch stubble height, but only 67% for the shorter height.

A related photo illustration of reduced ground cover for orchardgrass harvested at 2- and 4-inch residual stubble heights is shown in Figure 3. Because of these considerations, it is important to properly adjust the cutting height on mower-conditioners based on the physiological needs of the crop. For instance, alfalfa, Kentucky bluegrass, or

Figure 3. An orchardgrass stand cut at 2-inch (above) or 4-inch stubble heights (below) after two years of production in Wisconsin (photos by Dr. Geoff Brink, US Dairy Forage Research Center).

bermudagrass will tolerate closer defoliation than many perennial cool-season grasses because their growth reserves are not stored in upright stem or tiller bases. If stand persistence is important, a clipping height of about 4 inches is a reasonable recommendation for most perennial cool-season grasses. However, if the grass will be rotated to another crop in two or three years, persistence may be less important, and a producer may want to maximize harvested forage by using a shorter clipping height. It should also be noted that the referenced study (Brink et al., 2010) was conducted in Wisconsin with limited potential for severe summer heat stress. Results may differ at more southerly locations, where cool-season grasses may experience more stressful climatic conditions.

Summary

Perennial cool-season grass varieties should be selected with scrutiny of various characteristics evaluated or provided by state Extension or other reliable/unbiased sources. Depending on location, traits such as winterhardiness may be important. Generally, later-maturing varieties and more uniform seasonal yield distribution are preferred for these grasses. Establishment techniques should emphasize good soil-seed contact, proper planting depth, and proper timing based on local climatic norms and Extension recommendations.

Most perennial cool-season grasses store their growth reserves in stem or tiller bases. A 2-inch clipping height may result in short-term yield advantages, but this practice also may result in poorer persistence. A 4-inch clipping height is usually recommended for long-term persistence. However, if the grass stand will be rotated to other crops in two or three years, this management consideration becomes less important.

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