

# COOL SEASON ANNUAL AND PERENNIAL GRASS FORAGES FOR CALIFORNIA – A NEW PERSPECTIVE

Devesh Singh<sup>1</sup>

## ABSTRACT

There is an increase in awareness of the benefits of grass hay from an agronomic and nutritional perspective. The main cool season forage grass species adaptable to California are annual ryegrass, Italian ryegrass, perennial ryegrass, orchard grass and tall fescue. The main characteristics of these species along with attributes of different varieties are highlighted in this paper. The agronomic and nutritional benefits of soft-leaf tall fescue provide a new resource to the producers to obtain high quality grass hay.

**Keywords: cool season forage grasses, ryegrass, orchard grass, tall fescue, soft-leaf tall fescue, digestibility, palatability**

## INTRODUCTION

Several factors, including high demand for grass hay by horse owners, have increased the interest of hay growers in forage grasses. Farm managers at large dairies are including a grass crop in the cropping rotation to improve the efficiency of manure nutrient recycling. Beef producers are also increasing the consumption of grass hay with increase in demand for grass-fed beef. There is an increased in desire by confinement based dairies to use perennial grasses as source of fiber, energy, and protein in the diet of lactating cows. All of these factors have made production of forage grass hay, silage, and balage very attractive for farmers. However, information on adaptable forage grass species and improved varieties is limited. California's various climatic zones facilitate production of both warm season and cool-season grasses in different parts of the state. Cool season grasses are generally considered to have better forage quality than warm season grasses. The objective of this paper is to give a brief overview of adaptable cool season forage grass species with emphasis on Central California. Highlights of latest improvements in varietal characteristics of some perennial forage grass species will be discussed.

## BENEFITS OF FORAGE GRASSES

1. From agronomic and nutritional perspective, forage grasses and alfalfa are complementary. While nutrient requirements of alfalfa are minimal, production of forage grasses provide an opportunity to dispose excess nutrients generated as dairy manure. Selecting forages with high yield potential can effectively remove nutrients from effluent manure application. Cool season grasses are particularly effective in Phosphorus utilization.<sup>1</sup>

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<sup>1</sup> D. Singh, Director of Research, Barenbrug USA, P. O. Box 239, Tangent, OR 97389; Email: [dsingh@barusa.com](mailto:dsingh@barusa.com)  
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2. Grasses perform better in poorly drained soils not suitable for alfalfa production. Unlike management intensive alfalfa production, improved forage grass varieties have fewer disease and insect problems.
3. Adaptable cool season grasses can provide higher dry matter production (tonnage) by extending the growing season especially when grown in mixtures with alfalfa.
4. Forage grasses improve the herd health. Acidosis is the biggest nutritional problem in dairy and beef cattle in confinement dairies. High grain diets, which are rich in fermentable sugars and starch, depress the ruminal pH. Reduction in rumen pH limits dry matter intake and thus reducing milk production in lactating cows and body weight gain in beef cows. Acidosis is also linked to laminitis or lameness in animals which in turn increases the cull rate of a herd. Diets rich in fiber such as grasses improve the rumen function and prevent acidosis.
5. Grasses have more fiber than alfalfa; and fiber from high quality grass is more digestible than alfalfa fiber. Highly digestible fiber from forage grass improves the dry matter intake and feed concentrate intake, thus increasing milk production.<sup>2</sup>
6. Conjugated linoleic acid (CLA) is a naturally occurring fatty acid found in ruminants. CLA has been shown to be anti-carcinogenic and beneficial to human health. Ruminants on grass-fed diets have higher CLA in milk and meat than grain-fed diets.
7. Hay made from alfalfa mixed with high quality grass is highly desirable by horse owners as it provides a balanced nutrition (protein and fiber) to recreational horses.

### **CRITERIA FOR SELECTING FORAGE GRASS SPECIES AND VARIETY**

1. Consideration should be given to target application of grass in selecting a forage grass variety. Improved grass varieties are bred for specific application such as cutting/hay or grazing. Varieties developed for grazing system are tolerant to frequent defoliation to simulate grazing. Varieties developed for hay systems are adaptable to infrequent defoliation. Varieties suited for haying can tolerate damage to the growing point near the crown as it grows high above the soil surface in taller grass.
2. Depending on the production area, grass species/variety should be able to tolerate the stress from freezing, heat and drought. Usually a species/variety tolerates these stresses by going dormant. However, a highly stress tolerant cultivar can have extended dormant periods which reduces total production. In central California, with a long growing season, low dormancy cultivars with good heat and drought tolerance are desirable.
3. Grass species vary widely in their range of productive stand life. Annual ryegrass persists only for one cropping season where as Italian ryegrasses are productive for two cropping seasons. Perennial ryegrass stands are considered to be productive for three crop years. Tall fescue and orchard grass can persist for four years or longer; depending on persistence characteristics of the grass variety
4. Growth Rhythm of the grass variety is also a very important consideration. Various factors influence the optimum harvest window of a hay field. In areas with a wet spring, a grass that is early maturing or has more spring growth is not desirable as it will make harvesting of dry hay very difficult. In Central California, with long growing season a late maturing variety with uniform growth throughout late spring and summer is best suited.

5. Late maturing grasses are better suited for growing in mixtures with alfalfa as they match the growth rhythm of alfalfa and peak in production at the same time in summer.
6. Moisture content of the grass will affect the drying time. High moisture grasses are suited for silage production but low moisture grasses or grasses with reduced drying time will be better suited for hay making. Generally tetraploid ryegrasses are more suited for silage production as they have higher moisture content. Similarly, the drying time for perennial ryegrass will be longer than tall fescue.
7. Varieties used for haying should be resistant to lodging as lodged grass will cause problems during swathing and may also increase the incidence of disease in the canopy.
8. Tolerance to effluent water and nutrient uptake efficiency is important if the grass will be used for manure nutrient recycling. Generally tall fescue is most tolerant to salts in effluent water. However, a high dry matter producing Italian ryegrass might be more suited for nitrogen uptake and recycling.
9. Palatability of grasses is especially important in grazing situations. Higher palatable grasses have better intake than low palatable grasses. Palatability is measured through animal preference trials. The grass that is preferred by an animal over another is considered more palatable. Generally, grass with no disease (e.g. Rust) are more palatable than grasses with disease. Leaf flexibility (soft-leafiness) also improves the palatability of grasses. Palatable grasses also have better forage quality than unpalatable grasses.
10. Forage Quality (Energy, Digestibility) of the grass should be considered. Grasses grown for lactating cows should have higher quality than dry cows. Amongst the commonly grown forage grass species, perennial ryegrass has the best quality for lactating cows, where as forage quality of timothy is considered to be most suited for horses.
11. Grasses meeting all the criteria stated above should have high forage yields.
12. Choose certified seed of improved varieties, so the seed and plant performance is assured.

## **COOL SEASON FORAGE GRASS SPECIES FOR CALIFORNIA**

### **Annual Ryegrass (*Lolium multiflorum westerwoldicum*)**

Annual ryegrass is ideal for producing large biomass in a short period. It establishes rapidly, even after planting in cooler temperatures. Peak production of high quality forage from annual ryegrass is obtained from mid-spring to late spring. Annual ryegrass is the most widely used cool season grass species. In the southern U.S., it is used for over-seeding bermuda grass pastures for forage production in winter when bermuda grass is dormant. Annual ryegrass can also be grown in mixtures with winter cereals such as winter wheat and triticale. In this system, cereals provide forage in early spring and annual ryegrass fulfills the late spring forage needs. Annual ryegrass is a prolific seed producer. Once seed heads are formed its forage quality deteriorates quite rapidly. After harvesting annual ryegrass, fields can be used to plant a crop of silage corn. Forage grass breeders have developed annual ryegrass varieties with varied characteristics to meet the needs of forage producers (Table 1).

An annual ryegrass variety like *Ribeye* has an earlier maturity and will peak in production sooner than a later maturity variety such as *Jumbo*. *Ribeye* can be harvested sooner than *Jumbo* and the field be used for planting corn after annual ryegrass harvest. However, if it is not possible for the

farmer to go on the field early, the farmer can choose to plant a later maturity variety such as *Jumbo*. A tetraploid variety such as *Jumbo* offers more disease resistance and higher yields than the diploid variety *Ribeye*. Certain varieties, such as *Maximus*, will show more winter growth than *Jumbo* and are more suited in regions with fewer possibilities of freezing temperatures. Higher sugar and moisture content of tetraploid annual ryegrass makes them more suitable for silage making.

Table 1: Characteristics of a few annual ryegrass varieties

		Maturity	Winter Growth	Winter hardiness	Rust Resistance
Ribeye	Diploid	2	5	3	Medium
Maximus	Tetraploid	3	6	2	High
Jumbo	Tetraploid	4	5	3	High
Gulf / VNS	Diploid	? 2 ?	? 5 ?	? 3 ?	? Low ?

Maturity- Larger number means later in maturity;

Winter Growth- Larger number means more growth in winter;

Winter hardiness-Higher number means more tolerance to freezing temperatures.

VNS: Variety not stated. Characteristics of such varieties are not assured.

### Italian Ryegrass (*Lolium multiflorum*)

Italian ryegrass, unlike annual ryegrass, requires vernalization (plant subjected to cold temperature of 40-45 F for certain length of time) for seed head formation. If planted in spring, Italian ryegrass does not produce seed heads in the first summer, and hence produces very high quality forage. Similar to annual ryegrass, a good Italian ryegrass also produces very high biomass in a short period. Italian ryegrass varieties are later in maturity than annual ryegrass. Forage quality (leaf to stem ratio) of Italian ryegrass is better than annual ryegrass. Italian ryegrass is highly suited for green chop in confined dairies who want to include grass in the diet. Italian ryegrass is highly suited to manure nutrient recycling. Table 2 illustrates the various characteristics of Italian ryegrass varieties. *Bardelta* and *Barextra* are new varieties bred for higher forage yields and better winter growth.

Table 2: Characteristics of few Italian ryegrass varieties

		Maturity	Winter Growth	Winter Hardiness
Bardelta	Diploid	5	6	3
Bartissimo	Diploid	5	4	4
Barextra	Tetraploid	5	6	3
Barmultra	Tetraploid	5	4	3

### Perennial ryegrass (*Lolium perenne*)

Amongst all the perennial grasses in production, perennial ryegrass has the best forage quality for lactating cows. It is highly suited for grazing and is very palatable and digestible. However, it has had limited usage in U.S because it is less persistent than other perennial forage species. It requires intensive management for maximum productivity. It is the most widely used species in Europe. In the mid 90's, several European varieties were introduced into U.S. These varieties

showed good gains in beef and milk production. However, these varieties were only suitable for milder climates and had low drought and cold tolerance. This caused problems with poor persistence and stand loss. Newer varieties have been developed that show better heat and cold tolerance. Table 3 shows the characteristics of some of these varieties. Early and intermediate maturing varieties such as *BAR 1M*, *Mara*, *Barsprinter*, *Bargala* and *Remington* are more suitable for California than late maturing varieties. Early and intermediate maturing varieties peak in production before it becomes too hot in summer. Usually tetraploid varieties show better heat and drought tolerance than diploid varieties.

Table 3: Characteristics of few perennial ryegrass varieties

		Maturity	Winter Growth	Winter Hardiness
Bronsyn	Diploid	3	8	2
BAR 1M	Diploid	4	4	6
Mara	Diploid	5	3	7
Barsprinter	Diploid	5	3	7
Barnhem	Diploid	7	4	6
Bargala	Tetraploid	4	5	6
Remington	Tetraploid	5	4	6
Barsaxo	Tetraploid	7	5	6

### Orchard grass (*Dactylis glomerata*)

Orchard grass is probably the most common perennial forage grass grown in U.S. It is considered to be a palatable forage grass and is very persistent. Orchard grass is highly adapted to shallow and light soils. It has good drought tolerance, but does not perform well under water logging conditions. The biggest drawback of orchard grass is its slow establishment. Once established, it is a very persistent species. Orchard grass is the most common grass species used for interplanting with alfalfa. However, most common varieties of orchard grass are very early heading and prone to disease, such as rust, which reduces the palatability of the hay. Improved varieties, which are best suited for planting with alfalfa are later in maturity and have better palatability and digestibility. Late heading varieties also show better leaf to stem ratio. Table 4 shows the widely different characteristics of orchard grass varieties. Improved varieties, such as *Baridana* have better disease resistance to rust than older varieties, such as *Potomac*.

Table 4: Characteristics of few orchard grass varieties

	Maturity	Winter Growth	Winter Hardiness	Rust Resistance
Potomac	3	3	6	Low
Baridana	4	3	8	Very High
Barexcel	4	4	8	High
Baraula	5	4	7	High
Intensiv	5	3	8	Very High
Cambria	5	8	4	High
Barlemas	5	8	5	Very High

Increased rust resistance improves the palatability of the hay and total dry matter production. Later maturing varieties such as *Baridana* and *Intensiv* are preferred for planting with alfalfa as they have similar growth rhythms. Varieties such as *Cambria* and *Barlemas*, which have better winter growth than winter dormant cultivars (*Baridana* and *Intensiv*), can be used in areas where access to fields is not restricted in winter. Such winter growing varieties are highly suited for grazing situations. Varieties with high dry matter production, such as *Baridana*, with good rust resistance and good summer performance are suitable for hay production.

**Tall Fescue (*Festuca arundinacea*)**

Tall fescue is the most widely adapted forage in U.S. It is suitable for both light and heavy soils, wet and dry soils, and has excellent drought tolerance. Tall fescue is very deep rooted and prefers deeper soils compared to orchard grass. In U.S., most of the tall fescue pastures are sown with a tall fescue variety ‘*Kentucky 31*’. This variety is infected with an endophytic fungus that produces alkaloids within the plant and increases its persistence. However, these alkaloids are harmful to the cattle who consume the forage. The toxic and harmful effects of endophyte infected tall fescue have caused wide spread fear of all tall fescue hay. New varieties of tall fescue are developed to persist without endophyte. Such endophyte free varieties have high dry matter production. In California, tall fescue produces more dry matter than orchard grass. However, these endophyte free varieties have rough and coarse leaves which make them highly unpalatable with poor digestibility. All of these factors have kept the consumption of tall fescue hay low in a market that prefers high quality hay.

Tall fescue breeders at Barenbrug have developed endophyte free tall fescue varieties which have much softer leaves than traditional tall fescue. In animal preference trials these soft-leaf tall fescue varieties prove to be much more palatable than traditional rough leaf fescues (Table 5). The bite size of grazing animals is better on the soft leaf tall fescue varieties and it increases the intake of total dry matter.

Table 5: Palatability of tall fescue varieties measured in animal preference trials

	Palatability	
BAR FA 1BTR10	6.6	Very Soft-leaf
BAR 3FA BTR 9	6.2	Very Soft-leaf
Barolex	5.8	Very Soft-leaf
Dulcia	5.0	
Kentucky 31+	4.6	Rough leaf
Jesup Max-Q	4.6	Rough leaf
L.S.D (0.05)	0.6	

Early maturing varieties such as *Drover*; or intermediate maturing varieties such as *Barcarella*, are traditional tall fescue varieties with rough leaves (Table 6). Soft-leaf tall fescue variety such as ‘*BAR FA 6FRD*’ is used for producing better quality hay with increased digestibility. For very high forage quality hay production, late maturing varieties such as *Barolex*, or very late maturing variety *Bariane*, provide unique opportunities. Such late maturing tall fescue varieties are highly suitable for planting with alfalfa as they mature at the same rate as alfalfa. Moreover, these very

soft leaf tall fescues have better forage quality and higher digestibility than traditional rough leaf fescues (Table 7). These soft-leaf tall fescue varieties have lower lignin content that increases the overall digestibility of the hay.

Table 6: Characteristics of few tall fescue varieties

	Maturity	Winter Growth	Winter Hardiness	Trait
Fawn	2	7	5	Low Rust Tolerance
Drover	2	7	5	High Rust tolerance
Kentucky 31	3	6	6	Toxic Endophyte
BARCARELLA	3	6	6	Endophyte Free
BAR FA 6FRD	3	6	7	Soft Leaved
BAROLEX	4	6	7	Very Soft-Leaved
BARIANE	5	5	8	Very Soft-Leaved

Table 7: Forage quality at boot stage of different forage species and varieties\*

Variety	Species	% Protein	% ADF	% NDF	% IVDDM	
BAR 1M	Perennial ryegrass	16.9	31.1	55.5	90.9	
Pradel	Meadow Fescue	16.8	30.6	55.5	90.9	
Retu	Tall Fescue	15.5	33.4	57.2	85.9	Rough leaf
Barcel	Tall Fescue	16.8	31.2	54.7	88.7	Very Soft-leaved
Potomac	Orchard grass	16.7	34.5	64.2	84.2	
Baridana	Orchard grass	17.6	33.1	62.6	87.3	
Climax	Timothy	12.9	37.3	63.2	83.9	

\*Grass Trials in Ithaca, NY. Forage quality predictions by NIRS; ADF=acid detergent fiber; NDF= neutral detergent fiber; IVDDM=in vitro digestible dry matter (48 hour digestion)

## CONCLUSION

Improved forage grass varieties with different characteristics give hay growers more options within a species. This has renewed interest in grass hay production, as growers can identify varieties that fit their cropping system. New endophyte-free tall fescue varieties with very soft-leaf provide unique opportunities to hay growers and dairy farmers in California. These varieties are in a unique category of cool-season forage grass that are heat and drought tolerant; have good palatability and higher digestibility. Hay produced from such tall fescue varieties should bring premium prices for hay growers that has not been seen with traditional rough leaf tall fescue hay.

<sup>1</sup> Zhang, H., L.A. Redmon, B. Woods. Selecting Forages for Nutrient Removal from Animal Manure. Oklahoma Cooperative Extension Service Factsheet. F-2251.

<sup>2</sup> Cherney, D.J.R. J.H. Cherney and LE. Chase. 2002. Influence of Lucerne/fescue silage mixtures on milk production of early-lactation Holstein cows. Journal of Animal and Feed Sciences. 11: 555-564.