Annual Ryegrass Performance in Mississippi: Long-Term Yield Production

Annual ryegrass is the most important and versatile cool-season annual grass for livestock producers in Mississippi. In pasture and hay systems, annual ryegrass is a popular forage because of its ease of establishment, high nutritive value, high yields, and adaptability to a wide range of soil types. There are approximately 550,000 acres planted in Mississippi annually, either in a prepared seedbed or over-seeded into perennial, warm-season grasses.

Annual ryegrass can be established in pure stands or mixed with small grains and/or clovers for cool-season forage production. For these reasons, annual ryegrass is a staple for many cool-season grazing programs in Mississippi. Although the planting date varies with location, the best overall planting time is mid-September for prepared seedbed or late October if over-seeded on a warm-season perennial grass pasture. Seeding rates are 25 to 30 pounds per acre for pure stands (higher rate for sod seeding) and 20 pounds per acre for mixtures with small grains and/or clovers.

Annual ryegrass grows best at a soil pH of 6.0 to 7.0. Phosphorus and potassium levels should be in the medium to high range for optimum yields. Annual ryegrass is a heavy water-user, and productivity can be impacted by soil moisture levels and temperature. Ryegrass is very responsive to nitrogen fertilizer but is a heavy user. Nitrogen applications should be split into two to four applications during the growing season. The first nitrogen application should occur when the seedlings have germinated and are 2 to 3 inches tall. When established with clovers, a single nitrogen application in early winter is often recommended to limit annual ryegrass competition with the clover. Nitrogen applications in small increments ranging from 34 to 50 units of nitrogen per acre (approximately 75 to 110 pounds of urea per acre) should be applied throughout the season. However, fertilize according to soil-test recommendations for the desired yields in your area.

Reasonable productivity can be expected from mid-November to mid-May in the southern part of Mississippi and February to early May in the northern part of the state. Annual ryegrass should normally be allowed to reach a height of 8 to 10 inches before grazing begins. Typical stocking rates are 700 pounds live weight per acre in winter and 1,400 to 2,000 pounds live weight per acre in spring. As a hay option, annual ryegrass can provide 2,000 to 4,000 pounds of dry matter forage per acre depending on moisture and fertilization.

Types of Annual Ryegrass

There are more than 60 varieties of annual ryegrass commercially available. They are grouped into two different types based on their number of chromosomes (ploidy level) (**Table 1**). These two types include diploid and tetraploid varieties. Diploid varieties have two sets of chromosomes (2n = 14) in each cell; their cells are smaller in size with lower water (moisture) content; their plant structures (leaves and seed size) are smaller; and the plants tend to produce more tillers. Higher tiller density can provide a denser stand, be more competitive with weeds, and sustain production in lower fertility and wetter soils. Diploids also tend to have a more prostrate growth (horizontal) type, which allows the stand to be more persistent in heavy grazing scenarios.

On the other hand, tetraploid varieties have four sets of chromosomes (4n = 28) in each cell with larger cell sizes, wider leaves, larger seed size, greater content of soluble carbohydrates (sugar and starch), and less fiber content. Tetraploid varieties are developed by treating germinating seed with specific compounds that cause a mutation in the chromosome number. Tetraploids tend to have higher water content in their cells; therefore, animals will need to consume more forage to achieve the same dry matter intake than when grazing diploid types of annual ryegrass.

Tetraploids have a slower recovery after grazing than diploids because they do not tiller as aggressively. They can also be susceptible to overgrazing because of higher palatability. Since tetraploids do not tiller as vigorously as diploids, they could be good candidates for mixtures with clovers. In general, tetraploids tend to mature later than some diploids. Although these differences between annual ryegrass types may not be obvious early in the season, they can become more apparent as the season progresses and grazing pressure is implemented. A 5-year summary of annual ryegrass types across locations in Mississippi has indicated that diploids may provide a slightly higher seasonal yield than tetraploids, but the differences are very small from location to location (**Figure 1**). Each annual ryegrass type and variety has its strengths and weaknesses; make sure that you select one that provides the greatest advantage for your unique grazing situation. Your management and use, along with the environment, will play big roles in which variety you decide to plant for grazing purposes.

Table 1. Classification of annual ryegrass varieties based on ploidy level, maturity, and cold tolerance.

Ploidy Level	Variety	Maturity (Flowering)	Cold Tolerance
Diploid (2n)	Alamo	Late	Medium
	Assist	Mid	Medium to High
	Advance	Unknown	Unknown
	Bounty	Mid	Medium to High
	Brigadier	Early	Medium to High
	Bruiser	Late	Medium
	Bulldog	Early to Mid	Medium to High
	Dipper	Early	High
	DH-3	Early to Mid	High
	Ed	Late	High
	Fantastic	Early	Medium
	Florida 80	Early	Medium
	Florlina	Mid to Late	High
	Flying A	Early to Mid	Medium to High
	Fria	Late	Medium to High
	Graz-N-Go	Mid to Late	High
	Grits	Early to Mid	Medium
	Gulf	Early to Mid	Low to Medium
	Jackson	Mid to Late	High
	King	Mid	Medium
	Lonestar	Mid	High
	Magnolia	Mid to Late	Medium to High
	Marshall	Late	High
	Passerel	Late	High
	Passerel Plus	Late	High
	Ration	Mid to Late	High
	Ribeye	Mid	Medium to High
	Rio	Mid to Late	High
	Sirloin	Mid	Medium to High
	Southern Star	Mid	Medium to High
	Stampede	Mid to Late	High
	Surrey II	Mid to Late	High
	TAM 90	Mid to Late	Medium to High
	WD-40	Early	Medium
	Winterhawk	Early to Mid	High

Tetraploid (4n)	Andes	Mid	Medium
	Attain	Late	Low to Medium
	Beefbuilder	Early to Mid	Medium
	Big Daddy	Mid to Late	Medium
	Blizzard	Mid	Medium to High
	Chuckwagon	Mid to Late	Medium
	Credence	Mid	Medium
	Diamond T	Mid	Medium to High
	Earlyploid	Early	Medium
	Feast II	Mid to Late	Medium
	Florida Red	Mid to Late	Medium
	Hercules	Mid	High
	Jumbo	Late	Medium to High
	Maximus	Mid	Medium to High
	Meroa	Mid	Low to Medium
	Mondora	Mid	Low to Medium
	Nelson	Mid to Late	Medium to High
	Prine	Late	High
	Stricker	Mid to Late	Medium
	TAMTBO	Late	Medium to High
	Tetrastar	Mid	High
	Verdure	Mid	Medium to High
	Vivacious	Late	Medium

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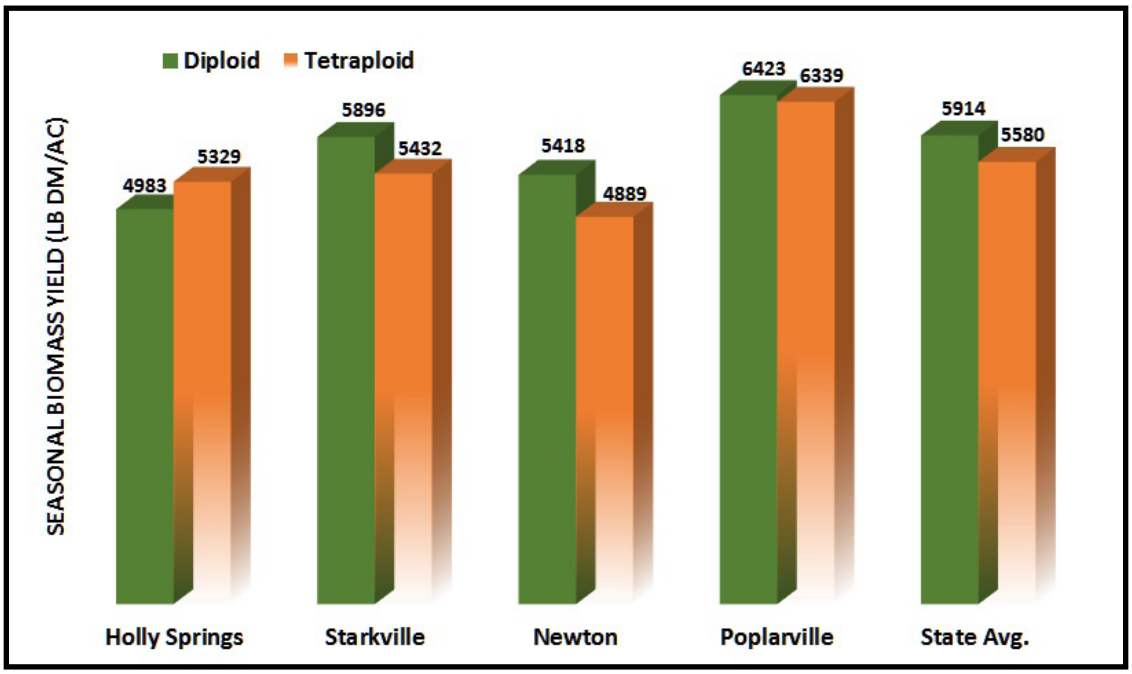

Figure 1. Biomass production of diploid and tetraploid annual ryegrass across different locations in Mississippi. Data summarized over 5-year average yields from 2012 to 2017. Source: White et al., 2013–2017.

Maturity of the variety is also important to determine which variety is more suitable for a grazing program. There are three categories in which ryegrass can be classified based on maturity: early, mid, or late (**Table 1**). This is especially important when over-seeding into warm-season pastures. Establishment of winter annuals into bahiagrass is likely to be more difficult than into bermudagrass. This is due to the competitive nature of bahiagrass, which grows later into the fall than bermudagrass and forms a tight root system because of the production of rhizomes.

Over-seeding permanent grass pastures with winter annuals usually decreases annual yield of the perennial grass to some extent as a result of shading and competition in spring. This is especially a concern with annual ryegrass because it grows so late into early summer and can impact the green-up of bahiagrass and bermudagrass. In this case, selecting an early- or mid-maturing variety is recommended, especially if the intended use of the warm-season pasture is hay production.

Establishment Considerations

When planting annual ryegrass, do your homework. Select varieties that have been tested, are adapted to your area, and can optimize winter grazing opportunities. Consult the forage variety testing information closest to your area. Select varieties that have adequate winter hardiness and have good germination and purity percentages. Plant early; the ideal planting window is from September 15 to October 31. Using this window will allow approximately 30 to 45 days of growth before a hard freeze and will provide some ground cover.

Understanding planting methods can also impact establishment and production potential. Using a drill will increase seed-to-soil contact and will require lower seeding rates. On the other hand, broadcasting the seed will require higher seeding rates. When over-seeding into existing perennial warm-season pastures such as bermudagrass or bahiagrass, it is recommended to use an early maturing variety to avoid possible delay in green-up that will affect summer grazing potential or hay production. Keep in mind that the important agronomic characteristics of an annual ryegrass are winter hardiness, good rooting depth, uniform growth, and high dry matter yields with good forage quality. For more information related to annual ryegrass variety trials, contact your local county MSU Extension office or visit Mississippi State University Forage Variety Trials at ***http://mafes.msstate.edu/variety-trials/forage.asp.***

Long-Term Yield Evaluation

Yield measurements from the variety trial are extremely important in determining the number of acres to plant, the amount of fertilization needed, and the number of animals that a grazing system can sustain. Knowing average yields will allow forage/livestock producers to better match nutrient applications to minimize costs, maximize fertilizer efficiency, and reduce potential environmental problems. Yields are also critical as a measuring tool to evaluate new varieties, improve management techniques, and allow producers to make more informed decisions concerning feeding practices for their livestock.

Knowing the estimated forage for winter grazing would allow producers to buy or sell forage at the time of the year that would be most feasible financially. Due to the number of annual ryegrass types and varieties available in the market, there is some confusion among producers when it comes to choosing the ideal one for a grazing system. The Mississippi State University Forage Variety Trial program evaluates a good portion of experimental and commercially available varieties every year to determine how they will perform across different locations. Entries into the variety trial program are submitted voluntarily into the program by seed companies, and the number of varieties might vary from year to year. Information from variety trials is used as a third-party verification of variety performance that allows livestock producers to make more informed decisions on what varieties might be more suitable for their area.

When available, using data from multiple years as an average might provide a better assessment on varietal performance than a single year, due to changes in weather conditions, especially temperature and precipitation, that could affect production from year to year. Data summarized in **Table 2** provides a better assessment of annual ryegrass production across the state. A 6-year mean yield of annual ryegrass ranges from 4,928 pounds per acre in Holly Springs to 6,464 pounds per acre in Poplarville. The state average dry matter yield was 5,649 pounds per acre. The overall yield potential of annual ryegrass is below the state average for Holly Springs and Starkville, while the largest increase in yield potential has been observed in Poplarville. This could be related to temperature and rainfall gradients across these locations during the growing season.

Across the state, diploid varieties have a slightly higher biomass production than tetraploid varieties, except

in Holly Springs. Performance of varieties across the state also indicated that 73 percent of the tetraploids may have negative relative yield (RY) compared to 33 percent of the diploid varieties. Data from the variety trial at Starkville has not reflected the yield advantage of tetraploids that has been observed in other locations across the southern U.S., but this could be dependent on management, fertility, and environmental conditions. Tetraploids might offer an advantage in forage production early in the spring season, but, by March, there is a balanced biomass production among the varieties.

Nutritive Value

Maturity is one of the most important factors that determines proper grazing and harvest time. Annual ryegrass is one of the highest quality forages that can be grown in the southern United States, but it can both grow and mature quickly. Annual ryegrass can maintain high levels of palatability, crude protein, and total digestible nutrients (energy) until the early stages of seed development (boot stage). However, nutritive value and palatability can rapidly decline late in the season under seedhead development. Most of the nutritive value

Table 2. Annual ryegrass performance in Mississippi: Six-year yield summary. Yields are expressed in pounds of dry matter per acre.

Variety	Years	Ploidy Level	Holly Springs	Starkville	Newton	Poplarville	State Avg.	RY (%)
Bulldog Grazer	3	Diploid	4305	5041	5032	5799	**5044**	**–10.9**
Ed	2	Diploid	3309	4611	6237	5897	**5014**	**–11.5**
Flying A	6	Diploid	5432	5242	5671	6570	**5729**	**1.2**
Fria	6	Diploid	5564	4826	5491	6803	**5671**	**0.2**
Jackson	6	Diploid	5309	5315	5600	5675	**5475**	**–3.3**
Lonestar	6	Diploid	5190	5676	5570	6936	**5843**	**3.2**
Marshall	6	Diploid	4496	6158	6528	6450	**5908**	**4.3**
Passarel Plus	2	Diploid	6755	6534	6952	6263	**6626**	**17.0**
Winterhawk	6	Diploid	5428	5805	5573	6777	**5896**	**4.1**
Attain	5	Tetraploid	5486	5618	6219	6975	**6075**	**7.3**
Big Boss	4	Tetraploid	5368	5548	5189	6722	**5707**	**0.8**
Diamond T	5	Tetraploid	4718	6705	6389	7418	**6308**	**11.4**
Earlyploid	3	Tetraploid	3462	5847	7635	5600	**5636**	**–0.5**
Jumbo	6	Tetraploid	4991	5080	5464	6002	**5384**	**–4.9**
Maximus	6	Tetraploid	4618	5601	5686	6693	**5650**	**–0.2**
Meroa	2	Tetraploid	5578	4944	5343	6552	**5604**	**–1.0**
Nelson	6	Tetraploid	4848	5441	5238	7030	**5639**	**–0.4**
Prine	4	Tetraploid	3927	4774	6073	6418	**5298**	**–6.4**
TAMTBO	6	Tetraploid	4950	5006	5032	6669	**5414**	**–4.4**
Tetrastar	6	Tetraploid	4835	4909	5495	6037	**5319**	**–6.1**
Location Avg.			**4928**	**5434**	**5821**	**6464**	**5662**	**—**
Relative Yield (%)			**–13.0**	**–4.0**	**2.8**	**14.2**	**—**	**—**

Note: This summary contains commercial varieties that have been tested in the Mississippi State forage variety trials for a minimum of 2 years across all locations from fall 2011 to spring 2017 (White et al., 2012–2017). Ploidy level refers to the number of chromosome sets in a biological cell and is often used in characterizing ryegrass varieties as either diploid (2x) or tetraploid (4x). Whether ploidy level is advantageous to a specific variety in regards to performance is more dependent on location. Relative yield (RY) is the potential of annual ryegrass to perform well at a specific location when compared to the overall state average biomass production. Relative yield (RY) was calculated as the percent increase in yield when comparing the average state performance of a variety to the overall state average: RY = ((Avg. Var – Avg. State)/Avg. State) × 100.

of annual ryegrass is in the leaves, and, as the season progresses, there is a change in leaf-to-stem ratio that causes a decline in nutritive value. This is usually related to an increase in fiber content of the stems, which translates into lower digestibility. Usually, high nutritional values can be sustained for 3 or more months during the growing season. **Table 3** is an example of the average nutritional value of annual ryegrass with maximum levels shown during the vegetative growth stage and minimum levels shown during the seedhead stage.

Summary

Livestock producers who depend on forages for most of their feed have a great interest in forage varieties. However, forage species, soil fertility, and harvest management all have greater effects on yield and quality than varieties within species do. Therefore, when selecting a variety, the key is to select one with a proven track record of good performance in the same region where it is to be used. Adaptation to soil conditions (soil type, drainage, pH), local climate (rainfall, minimum and maximum temperatures), and tolerance or resistance to local plant diseases and insect pests are the critical issues.

Table 3. Nutritive value of annual ryegrass grown in Mississippi. Values expressed on percent dry matter (DM) basis.

Component	N	Mean	Maximum	Range	Standard Deviation
			% DM		
CP	400	17.89	27.56	10.15	4.34
ADF	400	31.32	41.45	19.30	4.31
NDF	400	49.60	62.50	38.43	5.48
WSC	400	7.67	16.41	0.47	2.67
TDN	400	59.33	73.16	47.68	4.95
P	400	0.29	0.35	0.22	0.03
K	400	2.23	2.78	1.21	0.02
Ca	400	0.64	0.82	0.48	0.07
Mg	400	0.38	0.56	0.29	0.05

N = Sample Number; CP = Crude Protein; ADF = Acid Detergent Fiber; NDF = Neutral Detergent Fiber; WSC = Water Soluble Carbohydrates; TDN = Total Digestible Nutrients; P = Phosphorus; K = Potassium; Ca = Calcium; Mg = Magnesium.

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