August 2000 Circular Number 138

Cool-season Forage Crop Production on North Louisiana Coastal Plain Soil:

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A Summary of Varietal Studies on Annual Ryegrass, Cereal Rye, Tall Fescue, and Bromegrass

M.M. Eichhorn, Jr. , D.D. Redfearn, and B.C. Venuto

LSU AgCenter Research & Extension

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Cool-season Forage Crop Production on North Louisiana Coastal Plain Soil:

A Summary of Varietal Studies on Annual Ryegrass, Cereal Rye, Tall Fescue, and Bromegrass

M.M. Eichhorn, Jr.[1], D.D. Redfearn[2], and B.C. Venuto[3]

Annual ryegrass *(Lolium multiflorum* Lamb.), and cereal rye (*Secale cereale* L.), tall fescue *(Festuca arurndinacea* Schreb.), and bromegrass *(Bromus ssp.)*, are cool-season forage crops. In north Louisiana, both beef and dairy cattle producers depend heavily on cool-season annual forages, primarily annual ryegrass and cereal rye, to meet their winter-spring forage needs on pastures and as stored forage in the form of balage and/or silage. Tall fescue, a cool-season perennial forage, is not widely grown because plantings made on upland soils fail to persist several years after planting, and when compared with animal performance on annual ryegrass-cereal rye pastures, the production of beef and milk by grazing cattle tends to be lower. Bromegrass is also not widely grown because, until recently, seed of adapted disease-resistant varieties was not commercially available. The information presented herein is a summary of several varietal studies conducted at the Hill Farm Research Station (32°45'N, 93°04'W), Homer, La. The overall objective of these studies was to evaluate and identify varieties of these cool-season forage crops that offer highest forage yield potential for cattle producers in north Louisiana.

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Forage Yields of Annual Ryegrass Varieties on Prepared Seedbeds

Annual ryegrass is the most widely grown forage crop in Louisiana for cool-season production on pastures. Among commercially available varieties, Gulf is most widely grown across north Louisiana. Annual ryegrass variety performance trials were initiated in 1992 at the Hill Farm Research Station. Over 3 years of evaluation, 1992-95, annual forage yields of Gulf were not significantly different from those of Florida-80, Jackson, Marshall, Rio, Surrey, TAM 90, and Tetrablend 444[4]. Because the yield performance of several other commercially available annual ryegrass varieties had not been previously determined, additional performance trials were initiated in 1996. Objectives were (I) to determine seasonal forage yields, and (II) to identify varieties that offered highest yield potential throughout the growing season.

[4] Eichhorn, M. M. Jr., G. J. Cuomo, and B. C. Venuto. 1996. Performance of annual ryegrass and cereal rye varieties on north Louisiana Coastal Plain soil. Louisiana Agr. Exp. Stn. Circular 134.

Procedures

The yield performances of commercial annual ryegrass varieties including Abundant, Beef-Builder, Big-Daddy, Grazer, Gulf, Jackson, Marshall, Passerel, Rio, Rustmaster, Southern-Star, Surrey, and TAM-90 were evaluated for 3 years under a simulated pasture fertilizer and management program. The varieties were grown in a prepared seedbed on a Sacul fine sandy loam soil. The soil reaction (pH 5.4) was amended to pH 6.2 by applying 1 ton/A of dolomitic limestone prior to the initial planting year. Varieties were drill-planted annually at 30 lb seed/A in experimental plots that were arranged in a randomized complete block design with three replications of blocks.

Each year, 500 lb of 4-16-32 (N-P_2O_5-K_2O)/A was broadcast and incorporated to 3-inch soil depth prior to planting. Varieties were planted on October 5 in 15-foot long experimental plots with seven rows spaced 7 inches apart. Seed of each variety were planted at ½ inch soil depth. Three weeks after planting, all plots received a broadcast application of 300 lb of 30-0-0-8 (N-P_2O_5-K_2O-S)/A. After the second and fourth harvests, fertilizer 17-5-20-5 was broadcast on the plots at 575 lb/A. The applied annual fertilizer equivalent of N-P_2O_5-K_2O-S was 306-138-390-82 lb/A.

Varieties were harvested for dry matter yield determination throughout each growing season. The initial harvest (to 3-inch stubble height) was made when the majority of varieties exhibited 12- to 14-inch growth. Thereafter, harvests were made on approximate monthly intervals. Forage wet weight yields were recorded, percent dry matter determined, and dry matter yields per acre calculated. Yield data were subjected to statistical analyses using PROC GLM (SAS 1989) and means separation with Fisher's protected least significant difference procedure.

Results

Environmental conditions were favorable for the production of annual ryegrass on prepared seedbeds across years 1996-99. Average monthly temperatures and precipitation were above normal during the cool-season growing months, October through May. Annual forage yields among varieties are reported in Table 1. Across years, mean yield of varieties ranged from 7,251 lb for 1996-97 to 9,136 lb/A for 1998-99. Even though the mean yield of varieties varied widely across years, varietal yield, from lowest to highest, was not appreciably influenced (yr x var; P>0.05) by year effects.

Over all years, mean forage yield of varieties ranged from 7,926 lb for Passerel to 8,688 lb/A for Beef-Builder. Mean yields across years, however, were not significantly different (P>0.05) among varieties.

Table 1. Annual forage yields of ryegrass varieties, 1996-99

	Years			
Variety	1996-97	1997-98	1998-99	Mean
	Dry forage lb/A			
Beef-Builder	7422	9129	9512	8688a*
Abundant	7152	8916	9641	8568a
Marshall	7885	8169	9384	8478a
Rustmaster	7879	8457	9000	8448a
Big-Daddy	6383	9007	9331	8238a
Jackson	7442	7968	9114	8178a
Gulf (Commercial)	6979	8277	9132	8130a
Rio	7225	7930	9201	8118a
TAM-90	6861	8254	9157	8088a
Grazer	7913	8000	8134	8016a
Surrey	7229	8016	8770	8010a
Southern-Star	6859	7828	9091	7926a
Passerel	7027	7468	9280	7926a
Mean	7251C	8263B	9136A	

*Means having a common lower case letter within a column or upper case letter within a row are not different at the 5% level of probability.

Mean seasonal yields of annual ryegrass varieties over years are reported in Table 2. Results over all varieties showed that yields for December and January harvest dates were not different (P>0.05) and increased afterwards as the season progressed through April. From April to May, yield decreased.

Results also showed that yields among varieties were not different (P>0.05) on late fall (December) and winter (January and February)harvest dates. Grazer out-yielded (P<0.05) Gulf, TAM-90, and Passerel in March. Beef-Builder and Big-Daddy out-yielded (P<0.05) Jackson, Gulf, Rio, Grazer, Surrey, Southern-Star, and Passerel in April. In May, Beef-Builder out-yielded (P<0.05) all varieties with the exception of Abundant. May yield for Abundant was not different (P>0.05) from that of Beef-Builder or Marshall, but it out-yielded (P<0.05) all other varieties.

Table 2. Three-year mean seasonal yield performance of annual ryegrass varieties, 1996-99

Variety	Harvest dates					
	6 Dec	13 Jan	14 Feb	15 Mar	14 Apr	16 May
	Dry forage lb/A					
Beef-Builder	504a	530a	782a	1120ab	3416a	2336ab
Abundant	461a	468a	719a	1197ab	3320ab	2404a
Marshall	568a	587a	740a	1203ab	3269abc	2111bc
Rustmaster	532a	623a	728a	1221ab	3277ab	2065cd
Big-Daddy	530a	552a	685a	1105ab	3437a	1931cde
Jackson	628a	607a	695a	1253ab	3027cde	1965cde
Gulf (Commercial)	647a	526a	690a	1042b	3138bcd	2086cd
Rio	645a	647a	760a	1179ab	3013de	1875cde
TAM-90	638a	673a	658a	1050b	3292ab	1779e
Grazer	542a	606a	720a	1313a	2882e	1953cde
Surrey	603a	633a	864a	1225ab	2834e	1852de
Southern-Star	521a	642a	742a	1222ab	2931de	1866de
Passerel	556a	542a	678a	1056b	3137bcd	1965cde
Mean	567E	587E	728D	1168C	3152A	2014B

*Means having a common lower case letter within a column or upper case letter within a row are not different at the 5% level of probability.

Forage Crop Results

Seasonal yields of annual ryegrass varieties Abundant, Beef-Builder, Big-Daddy, Grazer, Gulf, Jackson, Marshall, Passerel, Rio, Rustmaster, Southern-Star, Surrey, and TAM-90 were evaluated for 3 years on prepared seedbeds of Sacul fine sandy loam soil. Varieties were fertilized and managed to simulate monthly production on pasture. Results revealed the following:

1. Abundant, Beef-Builder, Big-Daddy, Grazer, Gulf, Jackson, Marshall, Passerel, Rio, Rustmaster, Southern-Star, Surrey, and TAM-90 each produced nearly equivalent total, seasonal forage yield.
2. Forage yield potential during late fall or winter months was not significantly different among varieties.
3. Beef-Builder, Abundant, Marshall, and Big-Daddy were the leading forage producers during the spring months.

Overall, the results of the annual ryegrass yield performance trials identified 13 varieties that were acceptable for cool-season forage production on pastures where the seed were drill-planted into prepared seedbeds. Several varieties were identified as superior producers of forage in the spring months. These varieties exhibited good production for grazing livestock during the fall and winter months followed by either grazing, balage, haylage, and/or hay production in the spring months. These results will be helpful to livestock producers in north Louisiana when annual ryegrass varieties are selected for fall pasture plantings in prepared seedbeds. Where prepared seedbeds are intended to be planted to cereal rye over-seeded with annual ryegrass, all of the varieties should provide greater yields during the spring months. [Note: Pastures planted to variety Gulf have exhibited severe winter-kill in other trials when December and January temperatures plunged below 15^0 F.]

Balage Yield and Quality of Annual Ryegrass Varieties in Bermudagrass Sod

Producing annual ryegrass for balage or hay on bermudagrass sod provides livestock producers an opportunity to obtain high yields of high quality forage on the same acreage devoted to bermudagrass hay production. When both yield and forage quality of annual ryegrass peak during the spring of the year, environmental conditions are rarely favorable in north Louisiana for dry hay production. However, high moisture balage production offers a viable harvest option during this time period. Because information was limited on balage yield and quality of annual ryegrass varieties intended for plantings on bermudagrass sod, this study was conducted. Objectives were to (I) determine balage yield and forage quality including crude protein and total digestible nutrients, and II) identify varieties that have high potential for balage production on bermudagrass sod.

Procedures

Annual ryegrass commercial varieties Certified Gulf, Commercial Gulf, Florida-80, Jackson, Marshall, Rio, Southern Star, Surrey, TAM-90, Tetrablend-444, and WVPB-AR-90-300 were evaluated for 2 years, 1992-94, under a simulated balage fertilization and management program. The varieties were grown on a Darley fine sandy loam soil. The soil reaction (pH 4.8) was amended to pH 6.5 by applying 3 tons of super-fine high-mag lime/A prior to the initial planting year. Seed was drill-planted annually into an established Coastal bermudagrass sod at 30 lb seed/A placed at ½-inch soil depth in experimental plots arranged in a randomized complete block design with three replications of blocks.

On 15 October of each year, the bermudagrass on the experimental area, following a September hay harvest, was cut to 2-inch stubble height and forage removed. After making a broadcast application of starter fertilizer at 700 lb/A of 4-16-32 (N-P_2O_5-K_2O), all varieties were planted on 20 October in 15-foot length experimental plots with seven rows spaced 7 inches apart. On 20 February, 350 lb/A of 28-0-0-8 (N-P_2O_5-K_2O-S) fertilizer was broadcast on the plots. Following the initial harvest of varieties, 575 lb/A of 17-5-20-5 (N-P_2O_5-K_2O-S) was broadcast on the stubble. The applied annual fertilizer equivalent of N-P_2O_5-K_2O-S was 224-141-339-57 lb/A.

Varieties were harvested to a 3-inch stubble height when the majority exhibited mixed flag-leaf to pre-flower seedhead growth development. Average harvest dates were 10 April and 4 May. Forage wet weight yields were recorded, sampled, percent dry matter yield determined, and dry matter and balage yields calculated. Forage quality analyses were determined at the Southeast Research Station's Forage Quality Laboratory. Yield and forage quality data were subjected to statistical analyses using PROC GLM (SAS 1989) and means separation with Fisher's protected least significant difference procedure.

Results

Environmental conditions across the cool-seasons of years 1992-94 were favorable for balage production of annual ryegrass on bermudagrass sods. Average monthly maximum and minimum temperatures, 63.4 and 42.5°F, were near normal, while average monthly precipitation, 4.8 inches, was also near normal.

Yields

Across harvest dates, neither the yields of dry matter, crude protein, nor total digestible nutrients were significantly different ($P>0.05$) among ryegrass varieties (Table 3).

Among harvest dates, yields over all varieties were greater ($P<0.05$) in early April than in early May.

Table 3. Two-year mean dry matter (DMY), crude protein (CPY), and total digestible nutrient (TDNY) yields of annual ryegrass varieties harvested at balage growth stage development, 1992-94

	Mean harvest dates in balage growth stage					
	10 April			4 May		
Variety	DMY	CPY	TDNY	DMY	CPY	TDNY
		ton/A			ton/A	
TAM-90	2.12a*	.28a	1.42a	1.20a	.19a	.82a
Jackson	1.87a	.27a	1.30a	1.28a	.21a	.89a
Surrey	1.88a	.27a	1.30a	1.27a	.21a	.88a
Gulf-Commercial	1.91a	.29a	1.31a	1.15a	.18a	.79a
Gulf-Certified	1.87a	.27a	1.28a	1.18a	.19a	.82a
Southern-Star	1.69a	.25a	1.17a	1.28a	.19a	.88a
Florida-80	1.72a	.26a	1.19a	1.22a	.21a	.86a
Tetrablend-444	1.78a	.27a	1.22a	1.13a	.18a	.78a
Marshall	1.70a	.25a	1.19a	1.19a	.20a	.83a
Rio	1.52a	.22a	1.05a	1.20a	.19a	.83a
WVPB-AR-90-300	1.56a	.23a	1.07a	1.12a	.17a	.77a
Mean	1.78A	.26C	1.23E	1.20B	.19D	.83F

*Means having a common lower case letter within a column or upper case letter within a row by yield parameter are not different at the 5% level of probability.

Yield and forage quality

Mean annual dry matter yields and contents of crude protein and total digestible nutrients are reported in Table 4. Results showed that yields and crude protein contents were not different ($P>0.05$) among varieties and averaged 2.99 ton/A and 15.2%, respectively. Total digestible nutrient contents ranged from 67.8% for TAM-90 to 70.4% for Marshall and averaged 69.26%. Marshall, Florida-80, and Surrey were each higher ($P<0.05$) in total digestible nutrients than TAM-90, Commercial Gulf, and Tetrablend-444.

Table 4. Two-year mean annual dry matter yields (DMY) and contents of crude protein (CP), and total digestible nutrients (TDN) of annual ryegrass varieties harvested in balage growth stage, 1992-94

Variety	Yield DMY	DMY concentration	
		CP	TDN
	ton/A	%	
TAM-90	3.33a*	14.28a	67.86e
Jackson	3.15a	15.33a	69.57abcd
Surrey	3.15a	15.42a	69.87abc
Gulf-Commercial	3.06a	15.25a	68.65de
Gulf-Certified	3.05a	14.95a	69.26bcd
Southern-Star	2.97a	14.43a	69.09bcd
Florida-80	2.94a	16.18a	70.08ab
Tetrablend-444	2.91a	15.43a	68.73de
Marshall	2.89a	15.60a	70.35a
Rio	2.73a	15.30a	69.38abcd
WVPB-AR-90-300	2.68a	14.97a	69.00cd
Mean	2.99	15.19	69.26

*Means having a common lower case letter within a column are not different at the 5% level of probability.

Balage production

Annual ryegrass, harvested in balage growth stage, flag-leaf to pre-flowered seedhead development, will contain on average 80% to 85% moisture. To concentrate sugars in forage, while ensuring sufficient moisture for the grass to ensile, the grass is normally allowed to wilt to 50% moisture. Balage yields of forage, crude protein, and digestible dry matter over all ryegrass varieties are reported in Table 5.

Results showed that ryegrass varieties on average produced 5.96 ton/A of balage forage that contained .23 ton/A of crude protein and 1.09 ton/A of total digestible nutrients from the April and May harvests. Each of the yield parameters were highest ($P<0.05$) when the varieties were harvested in April.

Table 5. Two-year mean balage yields of forage (FY), crude protein (CPY), and total digestible nutrients (TDNY) of 11 annual ryegrass varieties, 1992-94

Harvest date	Balage† FY	CPY	TDNY
		ton/A	
10 April	3.56	.13	.67
4 May	2.40	.10	.42
	*	*	*
Sum	5.96	.23	1.09

*Significantly different at the 5% level of probability.
†Forage at 50% moisture in flag-leaf to pre-flower seedhead development.

Fertilizer nitrogen efficiency

Neither nitrogen uptake nor the removal of applied fertilizer nitrogen was significantly different ($P>0.05$) among varieties irrespective of harvest date. Over all varieties, where balage yields were 3.56 and 2.40 ton/A on April and May harvest dates, mean nitrogen uptakes were 83 lb and 61 lb/A, respectively, and 144 lb/A for the 5.96 ton/A annual balage yield (Table 6). Removal of fertilizer nitrogen applied prior to the April (126 lb N/A) and May (98 lb N/A) harvests were 66% and 62%, respectively, and 64% of the annual applied rate of 224 lb N/A. Both nitrogen uptake and removal of applied fertilizer nitrogen was highest ($P<0.05$)for the April harvest.

Table 6. Two-year mean balage yields, applied fertilizer nitrogen rates, crop uptakes of nitrogen, and crop removals of applied fertilizer nitrogen by 11 annual ryegrass varieties, 1992-94

Harvest date	Balage yield†	Nitrogen Applied	Nitrogen Uptake	Nitrogen Removal
	ton/A	lb/A		%
10 April	3.56	126	83	66
4 May	2.40	98	61	62
	*	*	*	*
Sum	5.96	224	144	64

*Significantly different at the 5% level of probability.
†Forage at 50% moisture in flag-leaf to pre-flower seedhead development.

Forage Crop Results

Seasonal balage yields and forage quality of annual ryegrass varieties Certified Gulf, Common Gulf, Florida-80, Jackson, Marshall, Rio, Southern Star, Surrey, TAM-90, Tetrablend-444, and WVPB-AR-90-300 were evaluated for 2 years on a Coastal bermudagrass sod. Varieties were fertilized and managed to simulate balage production on a bermudagrass hay meadow. Results revealed the following:

1. A late October planting of annual ryegrass into a Coastal bermudagrass sod had the potential to produce 3.56 and 2.40 ton/A of balage in April and May, respectively, and 5.96 ton/A annually.
2. Varieties Certified Gulf, Commercial Gulf, Florida-80, Jackson, Marshall, Rio, Southern Star, Surrey, TAM-90, Tetrablend-444, and WVPB-AR-90-300 were all highly adapted for balage production on bermudagrass sods.
3. Real differences in forage quality and yields of crude protein and total digestible nutrients were not apparent among varieties.
4. All varieties efficiently utilized fertilizer nitrogen applied as a starter fertilizer, in mid-February, and again after the April harvest.

Overall, the results of the annual ryegrass performance trials identified varieties suitable for ryegrass balage production on bermudagrass sods managed for bermudagrass hay production during the summer. Moreover, the annual balage yield potential of varieties and fertilizer nitrogen requirements were determined. These results will be helpful to livestock producers when selecting annual ryegrass varieties and determining nitrogen fertilizer needs for balage production on bermudagrass meadows.

Forage Yields of Cereal Rye Varieties on Prepared Seedbeds

Cereal rye is grown widely in north Louisiana for cool-season forage production on pastures. Among cereal grain forage crops, rye has been found at this location to produce highest seasonal yield. The higher yield performance for rye was attributed to seedling resistance to prolonged periods of drought in the fall, higher tolerance to below normal winter temperatures, and resistance to plant diseases. Among commercially available varieties, variety Elbon is most widely planted in north Louisiana. Cereal rye performance trials were initiated in 1992. Over 3 years, 1992-95, Maton, Bonel, and Wintergrazer 70 each produced significantly higher forage yield than Elbon[5]. Forage quality was not different among varieties across growing seasons. Because the yield performance of several commercially available rye varieties had not been previously determined, additional performance trials were initiated in 1996. Objectives were (I) to determine seasonal forage yields of varieties, and (II) to identify varieties that offered highest yield potential throughout the growing season.

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[5]Eichhorn, M. M. Jr., G. J. Cuomo, and B. C. Venuto. 1996. Performance of annual ryegrass and cereal rye varieties on north Louisiana Coastal Plain Soil. Louisiana Agr. Exp. Stn. Circular 134.

Procedures

The yield performances of cereal rye varieties, including AFC-20-20,Bates, Bonel, CGI-87, CGI-88, CGI-90, Elbon, Fayetteville, Maton, Oklon, Wintergrazer-70, and Wintermore-95, were evaluated for 3 years under a simulated pasture fertilizer and management program. The varieties, originating from commercial seed stocks, were grown on a Mahan fine sandy loam soil. The soil reaction (pH 5.5) was amended to pH 6.2 by applying 1 ton/A of dolomitic limestone prior to the initial planting year. Varieties were drill-planted annually at 90 lb seed/A in experimental plots that were arranged in a randomized complete block design with three replications of blocks on a thoroughly prepared seedbed.

Each year, 500 lb of 4-16-32 (N-P_2O_5-K_2O)/A was broadcast and incorporated to 3-inch soil depth prior to planting. Varieties were planted on October 5 in 15-foot long experimental plots with seven rows spaced 7 inches apart. Seed of each variety were planted at 1-inch soil depth. Three weeks after planting, the varieties received a broadcast application of 300 lb of 30-0-0-8 (N-P_2O_5-K_2O-S)/A. After the second and fourth harvests, fertilizer 17-5-20-5 was broadcast at 575 lb/A. The applied annual fertilizer equivalent of N-P_2O_5-K_2O-S was 306-138-390-82 lb/A.

Varieties were harvested for dry matter yield determination throughout each growing season. The initial harvest (to 3-inch stubble height) was made when the majority of varieties exhibited 12- to 14-inch growth. Thereafter, harvests were made on approximate monthly intervals. Forage wet weight yields were recorded, percent dry matter determined, and dry matter yields per acre calculated. Yield data were subjected to statistical analyses using PROC GLM (SAS 1989) and means separation with Fisher's protected least significant difference procedure.

Results

Environmental conditions were favorable for the production of cereal rye varieties during the cool-season months (October through April) for 2 years, 1997-99, of the 3 years varieties were evaluated. Above normal precipitation during the winter and spring months of the 1996-97 growing season reduced the yield potential of all varieties. Annual forage yields among varieties are reported in Table 7. Across years, mean yield of varieties by year was highest ($P<0.05$) for the 1997-98 growing season (7,158 lb/A) and lowest ($P<0.05$) for the 1996-97 growing season (4,355 lb/A). Even though the mean yield of varieties varied widely across years, varietal yield rank, from higher- to lower-yielding varieties, was not appreciably influenced (yr x var; $P>0.05$) by year effects.

Table 7. Annual forage yields of cereal rye varieties, 1996-99

	Years			
Variety	1996-97	1997-98	1998-99	Mean
	Dry forage lb/A			
Maton	5226	8130	6991	6783a*
Wintermore-95	4530	7882	6689	6367ab
Bates	4776	7311	6607	6235bc
CGI-90	4542	7208	6855	6202bc
Bonel	4512	7342	6638	6164bcd
Oklon	4218	7766	6407	6131bcd
Wintergrazer-70	4476	7612	6044	6044bcde
AFC-20-20	4608	6383	6898	5963bcde
CGI-87	3942	6729	6877	5850cdef
Elbon	3792	6704	6730	5742def
CGI-88	3708	6697	6608	5670ef
Fayetteville	3920	6137	6256	5439f
Mean	4355C	7158A	6633B	6049

*Means having a common lower case letter within a column or upper case letter within a row are not different at the 5% level of probability.

Over all years, mean forage yield of varieties ranged from 5,439 lb for Fayetteville to 6,783 lb/A for Maton. Maton out-yielded ($P<0.05$) all other varieties except Wintermore-95 ($P>0.05$). Moreover, in addition to Maton out-yielding ($P<0.05$) Elbon, the most widely grown cereal rye in north Louisiana, Wintermore-95, Bates, and CGI-90 also out-yielded Elbon.

Mean monthly seasonal yields of cereal rye varieties across years are reported in Table 8. Results showed that yield over all varieties for the December harvest was higher ($P<0.05$) than that of January. Thereafter, yield increased monthly from February through April.

Table 8. Three-year mean seasonal yield performance of cereal rye varieties, 1996-99

Variety	Harvest dates				
	5 Dec	11 Jan	13 Feb	15 Mar	10 Apr
	Dry forage lb/A				
Maton	771bcdef	619c	1128b	1724a	2543a
Wintermore-95	929ab	750abc	1254ab	1398bcd	2034bc
Bates	1031a	861a	1304a	1123f	1912bcd
CGI-90	858abcd	726abc	1216ab	1425bcd	1977b
Bonel	715cdef	645bc	1131b	1515b	2159b
Oklon	735bcdef	597c	1194ab	1534ab	2071bc
Wintergrazer-70	605f	622bc	1264a	1447bcd	2107bc
AFC-20-20	907abc	757abc	1187ab	1474bc	1638fg
CGI-87	816bcd	687abc	1169ab	1469bc	1709fg
Elbon	807bcde	611c	1066b	1532ab	1726ef
CGI-88	760bcdef	616c	1122b	1345bcd	1827def
Fayetteville	883abcd	764ab	1222ab	1065f	1506g
Mean	818D	688F	1188C	1421B	1934A

*Means having a common lower case letter within a column or upper case letter within a row are not different at the 5% level of probability.

Results also showed that yields among varieties differed (P<0.05) on each harvest date. Above average yielding varieties, during the late fall-winter months (December through February) of the growing season, were generally below average yielding varieties during the spring months (March and April). Concurrently, below average yielding varieties during the late fall-winter months were above average yielding varieties during the spring months. Among varieties, data indicated that Bates, Wintermore-95, Fayetteville, AFC-20-20, and CGI-90 provided greater yield potential during late fall and winter months. Maton and Oklon provided greater yield potential among varieties during the spring months.

Forage Crop Results

Forage yields of cereal rye varieties AFC-20-20,Bates, Bonel, CGI-87, CGI-88, CGI-90, Elbon, Fayetteville, Maton, Oklon, Wintergrazer-70, and Wintermore-95 were evaluated for 3 years on prepared seedbeds of Mahan fine sandy loam soil. Varieties were fertilized and managed to simulate monthly production on pasture. Results revealed the following:

1. Bates, Wintermore-95, Fayetteville, AFC-20-20, and CGI-90 were the leading producers of forage during late fall and winter months.
2. Maton and Oklon were the leading producers of forage during the spring months.
3. Maton and Wintermore-95 were the leading full season producers of forage.
4. Maton, Wintermore-95, Bates, and CGI-90 produced significantly higher full season yields than Elbon.

Overall, the results of the cereal rye forage yield performance trials identified varieties that produced highest yields within and across the growing season. These results will be helpful to livestock producers in north Louisiana when the selection of cereal rye varieties are made for fall plantings in prepared seedbeds. Where prepared seedbeds are intended to be planted to cereal rye over-seeded with annual ryegrass, varieties that provide greater yields during late fall and winter months should be given highest priority.

Yield and Nutritive Value of Tall Fescue Grass, Annual Bromegrass, and Annual Ryegrass Varieties on Prepared Seedbeds

In north Louisiana, the majority of acreage devoted to cool-season forage production is planted annually to annual ryegrass. The variety Marshall is the most widely grown cold tolerant variety. In addition to cold tolerance, the variety has been observed to have a high potential to reseed pastures annually, following an initial planting in prepared seedbeds. Varieties of tall fescue, a cool-season perennial forage, are not widely grown in north Louisiana because plantings fail to persist several years after an initial planting. Several varieties of tall fescue recently released by the Georgia Agricultural Experiment Station have been shown to produce acceptable forage quality for grazing livestock and to persist on Coastal Plain soils. Varieties of bromegrass are also not planted widely because seed of adapted, disease-resistant varieties were not commercially available. Matua bromegrass, a New Zealand variety of which seed is commercially available for planting, may have potential as a cool-season perennial or reseeding annual. Because information was limited on the performance of the tall fescue varieties released by the Georgia Agricultural Experiment Station, Matua bromegrass, and reseeding Marshall annual ryegrass, a variety performance study was initiated in 1995 at the Hill Farm Research Station. Objectives were to determine I) seasonal yields, forage quality, and persistence of improved tall fescue varieties, II) seasonal yields, forage quality, and volunteer re-seeding potential of annual ryegrass and bromegrass varieties, and III) the potential for tall fescue and/or bromegrass plantings to serve as an alternative or replacement for annual ryegrass plantings devoted to pasture production.

Procedures

Tall fescue varieties, including endophyte-infected (EI) Kentucky (KY)-31, Georgia (GA)-5, and GA-Jesup and endophyte-free (EF) GA Jesup, Marshall annual ryegrass, and Matua bromegrass were evaluated for 3 years under simulated pasture and management procedures. The varieties Marshall annual ryegrass, Matua bromegrass, and Ky-31-EI tall fescue originated from commercial seed stocks. The tall fescue varieties GA-5-EI, GA-Jesup-EI, and GA-Jesup-EF originated from seed stocks at the Department of Crop and Soil Sciences, University of Georgia, Athens. The varieties were grown on a Sacul fine sandy loam soil where the soil reaction (pH 4.2) was amended to pH 6.2 by applying 2.5 tons/A of dolomitic limestone.

Prior to planting, fertilizer 4-16-32 was broadcast on the surface of the study area at 500 lb/A and incorporated to 3-inch soil depth. Thereafter, 15-foot long experimental plots with seven rows spaced 7 inches apart were arranged in a randomized complete block design with four replications of blocks on a throughly prepared seedbed. On 18 October 1995, all of the varieties were drill-planted at 25 lb seed/A into the plots at ½-inch soil depth. Three weeks after seedling emergence, fertilizer 30-0-0-8 was broadcast at 333 lb/A. Thus, the planting year fall fertilization program was equivalent to applying 120-80-160-27 lb of N-P_2O_5-K_2O-S/A. Subsequently, annual spring and fall fertilization procedures on established sods consisted of a broadcast application of fertilizer 17-5-20-5 at 590 lb/A in mid-February and early October to provide 200-60-236-60 lb of N-P_2O_5-K_2O-S/A annually.

After establishment, the plots of tall fescue varieties were managed annually as perennial sods. The annual ryegrass and bromegrass variety plots were managed for volunteer re-seeding by shattering the seed from the mature standing culms (stems) with a leaf rake in late June. (The Matua bromegrass failed to exhibit perennial characteristics at this location.) Across years, including the planting year, stand coverage on the plots was visually rated on 1 December for persistency of tall fescue and reseeding ability of the annual ryegrass and bromegrass.

Varieties of forage crops were harvested for dry matter yield determination and sampled for forage quality analysis throughout each tall fescue cool- (fall-winter-spring) and warm- (summer) growing seasons. Harvests (to 4-inch stubble height) were made when the majority of tall fescue plots attained 14- to 16-inch height during the cool-season after planting and regrowth following a September harvest. During the summer, the varieties were harvested in July and September. Harvesting of the varieties was terminated when the stands of tall fescue failed to persist in the fall following the last summer harvest. On each harvest date, forage wet weight yields were recorded, percent dry matter determined, and dry matter yields per acre determined. Forage quality analyses were performed at the LSU Agricultural Center's Forage Quality Laboratory, Franklinton. Yield and forage quality data were subjected to statistical analyses using PROC GLM (SAS 1989) and means separation with Fisher's protected least significant difference procedure.

Results

Stand persistence

Environmental conditions were favorable for the production of tall fescue, and seeded or volunteer re-seeded annual ryegrass and bromegrass varieties, from October of 1995 through April of 1998 regardless of management systems. Beginning in April 1998 and continuing through July 1998, drought conditions prevailed. As shown in Table 9, all of the tall fescue varieties suffered severe stand-loss as a result of the drought. The annual ryegrass and bromegrass varieties failed to produce sufficient seed to re-establish volunteer stands. Stand persistence of Ky-31-EI amd Ga-Jesup-EI was greater (P<0.05), however, than that of either Ga-5-EI or Ga-Jesup-EF. Moreover, perennial stands of the tall fescue varieties were greater than the volunteer stands of annual ryegrass and bromegrass varieties. Over all varieties, stand persistency data indicated that further evaluation of forage crop performance was not warranted at any time following the 1997-98 cool-growing season.

Cool-season performance

Annual cool-season forage yields across varieties and years 1995-1998 are reported in Table 10. Results showed that the yield

Table 9. Visual stand establishment success and persistency ratings for tall fescue (TF) and drill-planted followed by volunteer re-seeding annual ryegrass (RG) and bromegrass (BG) varieties, 1995-98

		Year, 1 December			
Crop	Variety¶	1995	1996	1997	1998
		Rating 10 = 100% to 0 = 0% of developed stands			
TF	Ky-31-EI	10a*	9.1a	9.2b	3.7a
TF	Ga-5-EI	10a	9.6a	9.1b	1.8b
TF	Ga-Jesup-EF	10a	9.6a	9.5b	1.6b
TF	Ga-Jesup-EI	10a	9.4a	9.4b	3.3a
BG	Matua	10a	9.8a	9.9a	0.8c
RG	Marshall	10a	9.7a	9.9a	0.8c

*Means having a common lower case letter within a column are not different at the 5% level of probability.
¶EI = endophyte infected. EF = endophyte free.

for tall fescue during the planting year was highest (P<0.05) in the presence of Ga. Jesup EF. In the second and third year after planting, yield of tall fescue tended to be greater for Ga. Jesup EI among varieties; however, 3-year average yield showed no significant yield differences (P>0.05) among varieties. Results also showed that yield over years for Matua bromegrass was higher (P<0.05) than that of Marshall annual ryegrass with the yields from volunteer re-seeded stands of Matua bromegrass significantly or numerically higher than those of Marshall annual ryegrass in 1996-97 and 1997-98.

Over all, the cool-season yields of tall fescue varieties were lower (P<0.05) than those of Marshall ryegrass and Matua bromegrass during the year of planting. In subsequent years, perennial stands of tall fescue varieties produced either significantly or numerically higher yields than those of reseeded Marshall annual ryegrass or Matua annual bromegrass stands. Matua stands failed to exhibit perenniality from planted or reseeded stands.

Mean per harvest cool-season yields of varieties and percent contents of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and in vitro true digestibility (IVTD) over 13 harvests across years 1995 through 1998 are reported in Table

Table 10. Annual cool-season yields of tall fescue (TF), bromegrass (BG),and annual ryegrass (RG) varieties, 1995-96 through 1997-98

		Cool-season years			
Crop	Variety¶	95-96‡	96-97	97-98	Mean
		Dry forage, lb/A			
TF	Ky-31-EI	3252c*	7738a	5971b	5654a
TF	Ga-5-EI	2742c	7659a	6619a	5673a
TF	Ga Jesup-EF	4133b	7445a	5738b	5772a
TF	Ga Jesup-EI	3208c	7972a	6860a	6012a
BG	Matua	6008a	5955b	5884b	5949a
RG	Marshall	6052a	3803c	5490b	5115b

*Means having a lower case letter in common within a column are not different at the 5% level of probability.
¶EI = endophyte infected. EF = endophyte free.
‡Planting year.

11. Results showed that, where yields were not significantly different (P>0.05) among tall fescue varieties, CP concentrations were also not different among varieties with the exception of Ga-Jesup-EI having a higher (P<0.05) CP level than Ky-31-EI and Ga-Jesup-EF. NDF, ADF, and IVTD concentration levels were not different (P>0.05) among tall fescue varieties. Results also showed that even though the yield for the Matua bromegrass was nearly similar to the tall fescue varieties, CP concentration was lower (P<.05) and NDF, ADF, and IVTD concentrations were each higher (P<.05). Moreover, the CP concentration for lower yielding Marshall annual ryegrass was not different from that of the Matua bromegrass; NDF and ADF were each lower, while IVTD was higher.

Over all quality parameters, results showed that forage quality of tall fescue was a) not significantly different (P>0.05) among tall fescue varieties, b) significantly lower (P<0.05) than that of Marshall annual ryegrass, and c) on the basis of IVTD, significantly lower than that of Matua annual bromegrass. Results also showed that forage quality of Marshall annual ryegrass was greater (P<0.05) than the forage quality of Matua annual bromegrass.

Table 11. Three-year mean per harvest cool-seasonal forage yields and concentrations of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and in vitro true digestibility (IVTD) of tall fescue (TF), bromegrass (BG), and annual ryegrass (RG) varieties, over all harvests, 1995-98

		Forage†				
Crop	Variety¶	Yield	CP	NDF	ADF	IVTD
		lb/A	Content, %			
TF	Ky-31-EI	1305a*	20.25b	47.98b	24.21b	76.31c
TF	Ga-5-EI	1308a	20.48ab	48.04b	24.62b	76.00c
TF	Ga Jesup-EF	1332a	20.13b	48.25b	24.46b	75.69c
TF	Ga Jesup-EI	1386a	20.65a	48.07b	24.46b	76.04c
BG	Matua	1371a	18.81c	49.76a	25.76a	77.04b
RG	Marshall	1179b	18.62c	43.30c	23.32c	78.56a

*Means having a lower case letter in common within a column are not different at the 5% level of probability.

¶EI = endophyte infected. EF = endophyte free.

†Means of 13 harvests made during the cool-growing seasons; March through May 1996 (3 harvests), October through May 1996-97 (6 harvests), and November through May 1997-98 (4 harvests).

Summer season performance

Across years 1996 and 1997, the semi-dormant tall fescue varieties were harvested in mid-July and early September. In mid-July, residual forage straw of Matua bromegrass and Marshall annual ryegrass was also harvested, while in early September, volunteer mixed southern crabgrass-signalgrass stands were harvested in place of Matua bromegrass and Marshall annual ryegrass. Mean summer forage yields of tall fescue varieties and straw-warm-season-annual grasses in the presence of previously cropped Matua bromegrass and Marshall annual ryegrass are reported in Table 12. Results over years showed that summer yields among tall fescue varieties were not different ($P>0.05$) with the exception of Ga-Jesup-EI out-yielding ($P<0.05$) Ga-5-EI. Forage yield, harvested in the presence of previously cropped Matua bromegrass, was higher ($P<0.05$) than that harvested in the presence of Marshall ryegrass, but not different from the yields of the tall fescue varieties.

Mean per harvest summer forage yields and percent contents of CP, NDF, ADF, and IVTD of tall fescue varieties and forage in the presence of previously cropped Matua bromegrass and Marshall annual ryegrass across years 1996 and 1997 are reported in Table 13. Results showed that levels of CP, NDF, ADF, and IVTD were not different ($P>0.05$) among tall fescue varieties irrespective of yield differences. The yield and CP level of forage

Table 12. Annual summer season yields of tall fescue (TF) and residual straw-volunteer southern crabgrass-signalgrass originating from stands of bromegrass (BG) and annual ryegrass (RG) varieties, 1996 and 1997

		Warm-season yields		
Crop	Variety¶	1996	1997	Mean
		Dry forage, lb/A		
TF	Ky-31-EI	5418ab*	2196b	3807abc
TF	Ga-5-EI	4746bc	2079b	3411bc
TF	Ga Jesup-EF	5313b	2081b	3697abc
TF	Ga Jesup-EI	6444a	2120b	4282a
BG	Matua‡	4881bc	3178a	4029ab
RG	Marshall‡	3963c	2333b	3148c

*Means having a lower case letter in common within a column are not different at the 5% level of probability.

¶EI = endophyte infected. EF = endophyte free.

‡Residual forage of straw, southern crabgrass and signalgrass.

composed of Matua bromegrass straw and volunteer southern crabgrass-signalgrass were not different from those of the tall fescue varieties, but NDF and ADF levels were each higher ($P<0.05$), and IVTD level lower ($P<0.05$). Moreover, the yield of Marshall ryegrass straw and volunteer, annual warm-season grasses, though generally not different from those of the tall fescue varieties, contained lower ($P<0.05$) levels of CP and IVTD and higher ($P<0.05$) levels of NDF and ADF. In addition to lower yield, forage of Marshall ryegrass contained lower CP and IVTD and higher ADF levels than residual forage of Matua bromegrass.

Over all, these data indicated that the forage nutritive values of the tall fescue varieties was higher than those of residue straw-warm-season annual grasses following either Matua bromegrass or Marshall annual ryegrass production during the summer growth periods.

Table 13. Two-year mean summer forage yields and concentrations of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and in vitro true digestibility (IVTD) of tall fescue (TF) and residual straw-volunteer southern crabgrass-signalgrass originating from stands of bromegrass (BG), and annual ryegrass (RG) varieties, 1996 and 1997

		Forage†				
Crop	Variety¶	Yield	CP	NDF	ADF	IVTD
		lb/A	Content, %			
TF	Ky-31-EI	1904abc*	9.96a	54.61b	30.79c	68.76a
TF	Ga-5-EI	1706bc	10.01a	54.16b	30.68c	68.58a
TF	Ga Jesup-EF	1849abc	9.55a	53.66b	30.11c	69.21a
TF	Ga Jesup-EI	2140a	10.25a	54.73b	30.56c	68.28a
BG	Matua‡	2015ab	10.00a	61.31a	34.28b	63.62b
RG	Marshall‡	1574c	8.94b	61.11a	35.26a	60.86c

*Means having a lower case letter in common within a column are not different at the 5% level of probability.

¶EI = endophyte infected. EF = endophyte free.

†Means of 2 harvests made during each of the 1996 and 1997 warm-growing seasons; mid-July (1 harvest) and early September (1 harvest).

‡Residual forage of straw, southern crabgrass, and signalgrass.

Forage Crop Results

The yield and nutritive value of endophyte-infected Ky-31, Ga-5, Ga-Jesup, and endophyte-free Ga-Jesup tall fescue varieties, Matua bromegrass, and Marshall annual ryegrass were evaluated for 3 years, 1995-98, at the Hill Farm Research Station on a Sacul fine sandy loam soil. Tall fescue varieties were fertilized and managed to simulate forage production on pastures from a drill-seeded planting made into a prepared seedbed. The Matua bromegrass and Marshall ryegrass varieties were fertilized and managed to simulate forage production on pastures from a drill-seeded planting made into a prepared seedbed the initial year followed by volunteer re-seeding in subsequent years. Over all years, results revealed the following:

1. Fully established stands of the tall fescue, irrespective of variety, are not likely to survive a late spring-early summer drought as occurred in 1998.
2. Tall fescue varieties had the potential to produce approximately 3 tons/A of forage annually during the cool seasons and 2 tons/A during the summer seasons of the 3-year study.
3. Yield and forage nutritive value of tall fescue varieties across cool-season and summer growth periods were not sufficiently different among varieties Ky-31-EI, Ga-5-EI, Ga-Jesup-EI, and Ga-Jesup-EF to warrant a preference ranking for forage production on pastures. Since animal performance may be higher on endophyte-free rather than endophyte-infected tall fescue pastures, Ga-Jesup-EF would be the favored variety based on these data.
4. Matua bromegrass offered potential for cool-season forage production in north Louisiana when managed as a seeded and/or reseeding annual in absence of a spring drought.
5. Marshal annual ryegrass performed fairly well when managed for annual reseeding; however, yield following reseeding management was lower than the yield for tall fescue varieties and Matua bromegrass.
6. Summer forage production of straw-crabgrass-signalgrass following either Matua bromegrass or Marshall ryegrass offered no advantage over tall fescue production relative to yield or forage nutritive value.

Persistance of Tall Fescue Grass Varieties on Bermudagrass Sod

Tall fescue varieties including endophyte-infected (EI) Kentucky (Ky)-31, Georgia (Ga)-5, and Ga-Jesup and endophyte-free (EF) Ga-Jesup were drill-planted on 18 October 1995 at 25 lb seed /A into experimental plots arranged on Coastal bermudagrass sod and a throughly prepared seedbed. The plots, on Sacual fine sandy loam soil, were fertilized and managed similarly to simulate forage production on pasture. As shown in Table 14, fully established stands on Coastal bermudagrass sods failed to persist one year after planting. Fully established stands of the varieties on prepared seedbeds exhibited excellent persistence for 3 years before a spring-summer drought terminated the stands.

These data indicated that the tall fescue varieties could not withstand competition from Coastal bermudagrass during the warm-season (summer) part of the growing season. Producers would be well advised to avoid planting tall fescue into hybrid bermudagrass fields.

Table 14. Visual stand establishment success and persistency ratings of tall fescue varieties established on prepared seedbed (PPS) and Coastal bermudagrass sod (CBS)

	December			
	1995		1996	
Variety¶	PPS	CBS	PPS	CBS
	Rating 10 = 100% to 0 = 0% of developed stands			
Ky-31-EI	10a*	10a	9.1a	3.4a
Ga-5-EI	10a	10a	9.6a	2.9a
Ga-Jesup-EF	10a	10a	9.6a	2.7a
Ga-Jesup-EI	10a	10a	9.4a	0.5b

*Means having a lower case letter in common within a column are not different at the 5% level of probability.
¶EI = endophyte infected. EF = endophyte free.

Summary

The performance of annual ryegrass, cereal rye, tall fescue, and bromegrass varieties were evaluated at the Hill Farm Research Station on typical upland Coastal Plain soil. Where fertilized and managed for pasture production on fall-planted prepared seedbeds, a) seasonal yield performances of annual ryegrass and cereal rye varieties were determined, and the most adaptable varieties were identified, b) seasonal yield, forage quality, and persistence of tall fescue varieties and seeded-reseeding Matua bromegrass and Marshall annual ryegrass were determined. On fall-planted bermudagrass sods, a) the most adaptable annual ryegrass varieties were identified for balage production on the basis of seasonal yields and forage quality, and b) tall fescue varieties were found not to persist where fertilized and managed for pasture production on a hybrid bermudagrass sod.

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