SOUTHEAST RESEARCH STATION
FIELD DAY SUMMARIES
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LSU AgCenter
Southeast Research Station
Franklinton, La.

LSU AgCenter Research & Extension

Research Summary #153

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Note: For more detailed information on the summaries presented in this report, you may contact us at the Southeast Research Station Office (985-839-2322) or Forage Quality Lab (985-839-3740).

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Managing Heat Stress in Lactating Cows in South Louisiana and Mississippi

Jerry Ward

Introduction. The first thing that should be done for dairy cattle during heat stress is to provide adequate shade and drinking water for them. Preferably, the water should be under the shade with the animals. Cattle would rather stay cool and thirsty than travel in the sun to get a drink of water. Also the ration should be carefully formulated to provide adequate protein, energy, and minerals, especially sodium and potassium. This ration will need to be more concentrated than a ration fed during cooler weather to compensate for reduced intake. The ration will need to provide adequate fiber, but excess fiber needs to be minimized. Summer rations will typically contain 21 to 23% ADF and around 18% crude protein. To balance an ideal summer-time ration, you will need high quality forage. After these basic things have been provided, then it is time to move onto other management strategies to maximize feed intake and production during the summer.

Cow Cooling Study. After providing shade and fans, it is time to start using water to cool cows if possible. To measure the effects of sprinkling, we used 60 cows in a study. The cows were split into two equal groups based on lactation, production, and days in milk. Both groups were housed in the freestall barn with fans and fed the same ration. Fans ran 24 hours per day. The only difference was that one group was sprinkled for 2 minutes out of every 15 from 7 a.m. until 7 p.m. That resulted in 3500 gallons of water used per day (1.52 gal/min per sprinkler * 24 sprinklers * 8 minutes/hour * 12 hours). The nozzles we used soaked the cows to the skin in the 2 minutes and at the end of the 13-minute drying time they were almost entirely dry. It is important when using soaking sprinklers to make sure the cows are soaked to the skin for maximum effectiveness. Also allow the cows to dry between wettings. This will minimize water usage, waste disposal costs, and environmental wetness. In our system each extra minute of sprinkling during a wetting cycle would result in an extra 1750 gallons of water usage. Milk weights were measured at each milking and body temperatures were measured before each milking which started at approximately 3:30 a.m. and 2:30 p.m. Wetting cows decreased body temperature and increased milk production. There were larger milk responses in older cows than in heifers. Also, during the afternoon, cows responded to sprinkling to a greater degree than heifers. Cows and heifers that were sprinkled actually had slightly higher body temperatures in the morning. This is somewhat surprising at first. Remember that the sprinklers were turned off at 7 p.m. and all animals had the same amount of cooling during the night time. With the increased milk production, we are assuming that sprinkled cows were consuming more feed and the increased heat of fermentation caused by increased feed intake led to the slightly higher body temperatures in the morning. Milk fat and protein were not affected by sprinkling, but sprinkling tended to decrease somatic cell counts in older cows. The results are presented in Table 1.

Table 1. Effects of sprinkling on milk production, milk components, and body temperatures.

Measurement	Sprinkled	Not Sprinkled	Difference	Significance
All milk production, lbs	61.2	59.4	1.8	P=0.007
Heifer milk production, lbs	56.5	55.2	1.3	P=0.05
Cow milk production, lbs	66.1	63.9	2.2	P=0.04
Milk fat, %	3.1	3.0	NS	NS
Milk protein, %	3.0	3.0	NS	NS
All somatic cell counts	65,200	82,890	NS	NS
Heifer somatic cell counts	62,600	53,100	NS	NS
Cow somatic cell counts	59,300	107,500	48,200	P=0.15
All body temperatures am	101.9	101.7	0.2	P=0.01
Heifer body temperatures am	102.0	101.8	0.2	P=0.11
Cow body temperatures am	101.9	101.7	0.2	P=0.02
All body temperatures pm	102.4	102.9	0.5	P<0.01
Heifer body temperatures pm	102.8	103.1	0.3	P<0.01
Cow body temperatures pm	102.3	102.8	0.5	P<0.01

Yeast Feeding Study. Another strategy for dealing with heat stress that was investigated is the addition of yeast to the diets of transition cows. In each experiment we fed 2 oz of yeast per day starting 21 days prior to expected calving date and continued to feed yeast after calving at the rate of 4 oz per head per day. In 1999 and 2000, yeast was fed for 21 days after calving, which increased milk production. In 2002 yeast was fed for either 21 or 56 days after calving. In 2002 feeding yeast for 21 days had no effect on milk production, but feeding yeast for 56 days after calving increased milk production. The results are shown in Table 2.

Table 2. The effects of feeding yeast to transition cows during hot weather on milk production.

Year	With Yeast	Without Yeast	Difference	Significance
1999[1]	76.2	68.7	7.5	P<0.01
2000[1]	87.0	84.5	2.4	P=0.01
2002[2]	79.9	74.4	5.5	P=0.03

[1] Yeast fed 21 days before expected calving date until 21 days after calving.
[2] Yeast fed 21 days before expected calving date until 56 days after calving.

To battle the effects of heat during the summer-time, first make sure that water is available. Then provide adequate shade for the cows. Next, make sure that the ration is properly balanced for protein, energy, fiber, and minerals. Then add fans, followed by sprinklers. Then look to feed additives to increase feed intake and milk production. Unfortunately, there are no magic potions or silver bullets to defeat heat stress in Louisiana. However, through a combination of management and feeding strategies, milk production can be improved during the summer and early fall in South Louisiana and Mississippi.

Fat Supplementation of Early Lactation Holstein Cows Grazing Ryegrass-oat Pastures

Mike McCormick, Dennis French, Jerry Ward, and David Blouin

Justification/Objective: Pasture dairying systems continue to dominate the forage programs of approximately 400 hundred dairies located in southern Louisiana and Mississippi. Annual ryegrass is the primary winter forage grown in Louisiana and other southeastern states. The poor reproductive performance of high-producing cows grazing lush pastures is thought to result from an interaction between excess dietary protein, which may limit intake and elevate milk urea nitrogen (MUN) concentrations, and low dietary energy intake, which has been shown to suppress successful ovulations, reduce first service conception rate, and increase days non-pregnant in dairy cows.

Studies at our research unit and others indicate that grazing cows often lose excess body condition during the first 30 days after calving (more than 1 unit on a scale of 1 = thin to 5 = obese). Fat supplementation is a recognized means of increasing energy density of dairy cow diets, which may lower condition loss in early lactation cows. Feeding a high fat by-product, such as whole cottonseed, may be a means of economically incorporating fat into grazing cow diets without depressing rumen fiber digestibility and milk fat concentration. In the past, poor handling characteristics of fuzzy whole cottonseed have limited its incorporation into concentrate diets. However, producers now have access to EasiFlo, a starch-coated whole cottonseed product that flows through augers and bins in a manner similar to whole shelled corn.

The objective of the present study was to determine the effect of substituting approximately 5 pounds of starch–coated cottonseed (EasiFlo) for 5 pounds of a corn-soybean feed on lactation and reproductive performance of Holstein cows grazing ryegrass-oat pastures.

Procedures: Fifty-four mature Holstein cows were randomly assigned to grain diets containing 1) no supplemental fat **(Control)** or 2) supplemental fat from whole cottonseed (**WCS**). Grain diet ingredient and chemical composition are presented in the table. The study was conducted over two ryegrass-oat grazing seasons. Cattle grazed pasture from November 1 through April of each year. Cows received experimental grain diets for a minimum of 112 days (from calving through 112 days in milk).

Results and Conclusions: The grain protein content was slightly less than 14% for both diets. Although this level seems low, it appeared adequate for early lactation dairy cows grazing ryegrass pasture containing, on the average, 24.1% protein. Supplementing with **WCS** more than doubled the amount of fat in the grain diet compared to the **Control** diet, but overall diet energy level was increased only slightly. Supplementing with WCS increased the cost of the grain diet by $14 per ton or five cents per cow daily.

No differences were observed in 3.5% fat-corrected milk or cow body condition between the two test diets. Grain consumption averaged about a pound lower for WCS-fed cows than those offered the control diet. In a green chop study in which cows received experimental grain diets identical to those offered pasture, cows supplemented with WCS consumed 15% less ryegrass than controls. Based on these intakes, and the costs of the grain diets and ryegrass pasture, it cost approximately $2.02 and $2.00 per cow per day for the Control and WCS diets, respectively.

Though not statistically different, an 11.2 percentage unit increase in first service pregnancy rate was noted for cows receiving the WCS supplemented grain diet. More research with larger animal groups is needed to determine if this difference is real. Since no improvements in body weight or condition were noted with WCS supplementation, positive effects on fertility may be related to an indirect effect of specific fatty acids on the ovulation process.

Table 1. Concentrate composition and animal performance.

Item	Control	WCS[1]
Ingredient	------------- % air dry basis	-------------
Corn, grd.	67.0	52.0
Whole cottonseed	0.0	21.4
Soybean hulls	12.4	12.4
Soybean meal (48%)	11.8	5.4
Minerals	4.8	4.8
Molasses	4.0	4.0
Chemical composition (% DM):		
Crude protein	13.6 ± 1.3	13.7 ± 0.9
Crude fat	2.6 ± 0.4	6.0 ± 0.6
Acid detergent fiber	7.8 ± 1.8	13.6 ± 3.0
NE_L, MCal/lb	0.83	0.85
Animal Performance:		
Grain intake, lb dry weight	19.6	18.5
Ryegrass intake, lb dry weight	22.0	18.7
Grain costs/cow/d[2]	1.47	1.53
Ryegrass costs/cow/d[3]	0.55	0.47
Total feed costs/cow /d	2.02	2.00
3.5% fat-corrected milk yield	81.8	81.4
Butter fat, %	2.92	2.98
Body condition score (1-5 basis)	2.19	2.25
First service pregnancy rate, %	44.4	55.6

[1]Starch-coated whole cottonseed.
[2] Based on grain costs of $151 and $166 per ton for Control and WCS, respectively.
[3] Based on ryegrass cost of $50 per ton dry weight.

Effect of Bahiagrass Conservation Method on Lactation Performance of Holstein Cows

Mike McCormick

Justification and Objective: Bahiagrass is a summer perennial forage known for its persistence, disease and insect resistance, and productivity. However, the nutritional value of bahiagrass is usually lower than other summer and winter annual forages grown in Louisiana. Most baleage producers in Louisiana rely heavily on annual ryegrass as their primary baleage crop. Recent droughts and poor ryegrass growing seasons have forced dairymen to turn to summer forages, such as bahiagrass, for their baleage needs. Bahiagrass is known to contain less than one-fifth the quantity of fermentable sugars found in ryegrass. These low sugar levels may hinder the successful storage of bahiagrass as baleage. The objective of the present study was to evaluate the effect of storing bahiagrass as outdoor-stored hay, indoor-stored hay, and baleage on storage losses and nutritional value.

Procedures: A 12-acre field of four-week old bahiagrass was cut with a mower conditioner beginning about 2 p.m. After allowing the forage to wilt in the initial windrow for 24 hours, approximately 1/3 of the field was baled (round bales), wrapped in six layers of stretch-wrap, and stored outside. Twenty-four hours later, the remainder of the field was baled as dry hay. Approximately half the hay bales were stored indoors and the other half were stored outdoors. All bales were core-sampled and weighed. Following a six-month storage period, bales were again cored and weighed. At the conclusion of the storage period, bales were ground and fed to appetite to 30 mid-lactation Holstein cows (10 per diet). Cows were individually fed forage morning and evening in a Calan Gate Research Barn. Fourteen pounds of a corn-soybean meal based grain diet was fed twice daily immediately prior to milking. Cow milk yield was measured at each milking, and milk composition, body weight, and body condition score were measured weekly. The study duration was seven weeks.

Results and Conclusions: A summary of the results are presented in the table. Baleage bales, though smaller (4 x 4.5 ft) than conventional hay bales (4 x 6), weighed about 1500 pounds compared to about 1100 pounds for hay bales. However, baleage bales contained 50% moisture compared to less than 20% for hay. This emphasizes the need for producers to plan on making twice as many baleage bales as hay bales to meet livestock needs. Storage losses for hay stored out-doors were nearly four times as great as that stored in the barn, while baleage storage losses were negligible. Bahiagrass baleage was well fermented and essentially free of mold. Hay stored outdoors experienced a substantial increase in fiber (ADF), which markedly reduced hay energy value. Nutritional value of indoor hay and baleage was similar. Lower forage quality and intake for outdoor-stored hay resulted in about 5 pounds less milk per cow per day than hay stored indoors. Milk production of baleage-fed cows was intermediate to those receiving outdoor and indoor stored hay. Slightly lower milk yield for baleage than indoor hay was likely related to lower forage dry weight consumption. Wet baleage bales were stored a maximum of 48 hours after grinding (prior to feeding). It is possible that as the weather warmed in the spring, bahia baleage may have experienced some heating prior to feeding, which may have limited intake. In summary, bahiagrass proved a successful candidate for conservation as baleage. Lower storage losses and higher milk yield support the baleage system over outdoor stored hay; however, storage losses and feeding value of barn-stored hay and baleage were similar.

Table 1. Effect of Conservation Method on Nutrient Composition, Storage Losses, and Feeding Value of Bahiagrass.

	Conservation Method			
Item	Outdoor Hay	Indoor Hay	Baleage	P[1]
Nutrient Composition, %				
Dry matter	79.7	88.7	50.2	*
Protein	13.6	12.8	12.9	NS
Acid detergent fiber (ADF)	44.5	38.4	39.0	*
Neutral detergent fiber (NDF)	76.6	73.0	68.9	*
Net Energy Lact.(MCal/lb)	0.53	0.60	0.60	*
Storage losses				
Initial bale wt, lbs	1267	1318	1497	
Final Bale wt, lbs	1089	1200	1489	
Dry matter loss, %	12.8	2.9	0.1	*
Net energy loss, %	10.4	4.6	1.6	*
Protein loss, %	0.1	0.1	0.1	NS
Lactation Performance				
Forage intake, lbs/d fresh	25.5	27.2	39.5	*
Forage intake, lbs dry wt/d	20.2	24.0	19.6	*
Grain intake, lbs dry wt/d	24.9	24.9	24.9	NS
Total dry matter intake, lbs/d	45.1	48.9	44.5	*
Milk yield, lb/d	59.7	66.1	64.1	*
3.5% FC-milk, lb/d	59.8	64.9	63.2	*
Milk fat, %	3.53	3.35	3.30	NS
Milk protein, %	3.01	3.03	3.02	NS
Body condition score (1-5)	2.42	2.50	2.47	NS
Body weight, lbs	1460	1468	1462	NS

[1]* Denotes statistical significance between means and NS denotes no significant difference.

The Prediction of Calf Sex by Polymerase Chain Reaction (PCR) DNA Analysis of Holstein Semen

John E. Chandler, Mike McCormick, Doug McKean, Herb Rycroft, Anita Canal and David Blouin

Justification/Objective: In recent years, polymerase chain reaction (PCR) DNA analysis of bull semen has found that there is significant variation from ejaculate to ejaculate in %Y-chromosome DNA bearing spermatozoa (%YCDBS). Also, it has been shown that there was variation in percentage males born; in both DHI calving and swine litter data. These works lack the data to correlate the %YCDBS per ejaculate with actual % male calves in a calf crop.

The objective of the present study is to use PCR analysis to evaluate the DNA from semen for percentage of Y-chromosome bearing spermatozoa (%YCDBS). This semen is to be used to breed the LSU AgCenter's Southeast Research Station dairy herd (cows and heifers). The semen will be critiqued for %YCDBS by PCR from the same ejaculate (lot), and these data will be correlated to the resulting % male calves calculated from the sex of calf data. The predictability %YCDBS will be evaluated on the percentage of male calves born to these breedings.

Procedures:

Breeding methods: At least 38 breedings were done with semen from each of three (3) ejaculations. That should produce about 19 calves per ejaculate or 57 calves per bull. There were four Holstein bulls were used in the study.

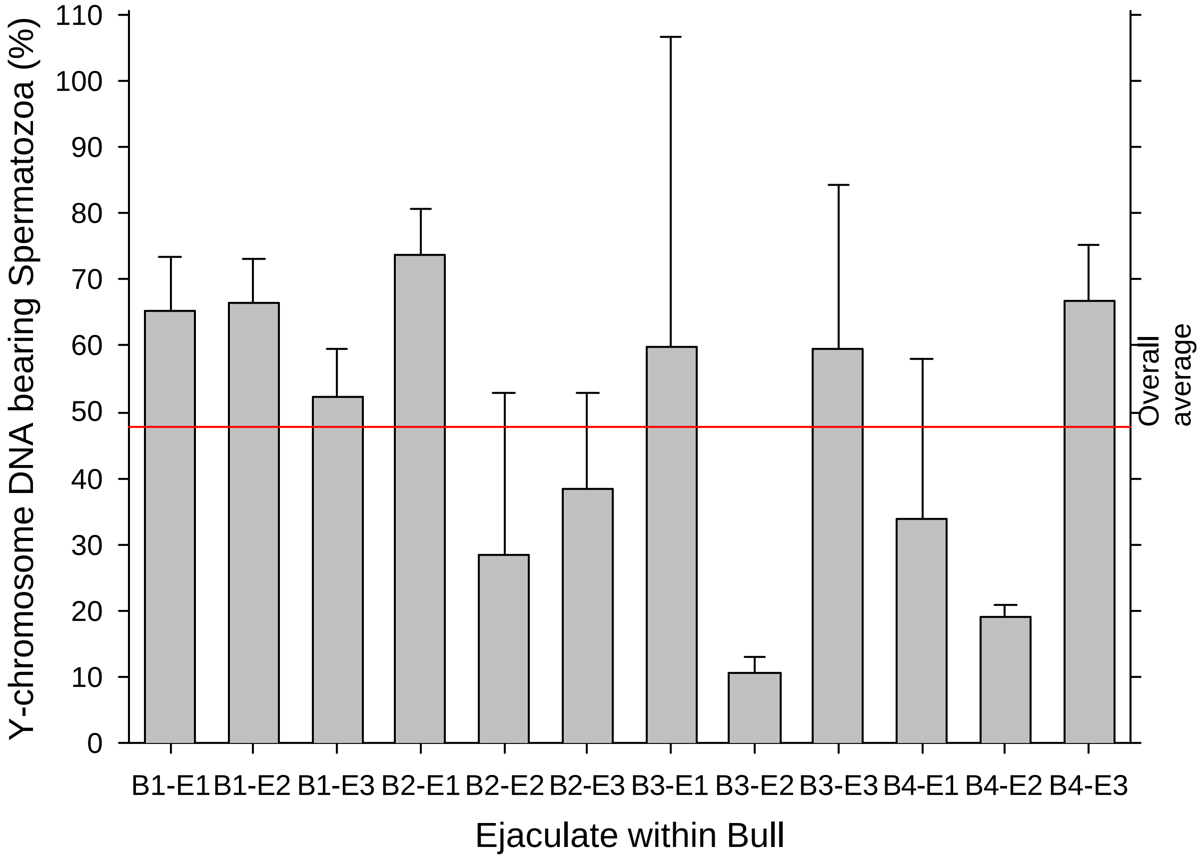
The four bulls were selected to match the genetic progress at the Southeast Research Station and were used in the experiment for the 2002-2003 breeding year. The sex of calf data is being collected during the calving season of 2003 and sent to Baton Rouge for statistical analysis.

DNA Analysis: Ten units from each ejaculate will be used to analyze the %YCDBS by methods established in the Male Physiology Laboratory at the T.E. Patrick Dairy Improvement Center in Baton Rouge.

Semen Analysis: Semen quality will be evaluated for each of the ejaculates and related to the breeding success rate for each ejaculate/bull combination.

Results and Conclusions:

DNA Analysis. Figure 1 illustrates the results of the DNA analysis performed on the semen used to breed the cows at the Southeast Research Station during the breeding season of 2002-3. The statistical analysis showed that the overall average %YCDBS across all ejaculates was very close to the expected value of 50%. However, the analysis did reveal considerable variation due to a highly significant ejaculate within bull effect. This is demonstrated by the difference in bar heights in Figure 1. Breeding/calving Data: These data are currently incomplete because the calving season has only been going for about a month. These data should be complete by December 2003.


Y-chromosome DNA bearing Spermatozoa (%)
0
10
20
30
40
50
60
70
80
90
100
110
Overall
average
B1-E1
B1-E2
B1-E3
B2-E1
B2-E2
B2-E3
B3-E1
B3-E2
B3-E3
B4-E1
B4-E2
B4-E3
Ejaculate within Bull

Dairy Waste Management Research , LSU AgCenter

Caye Drapcho, Eric Achberger,
Jerry Ward, and
Brian LeBlanc

I. Progress Report of Past Research

1. Introduction.

Field-scale research was conducted at the Southeast Research Station to determine the impact of dairy cattle grazing on the fecal coliform bacteria (FC) and *E. coli* counts in surface runoff. The specific objectives were: 1) to determine the FC and *E. coli* concentration in surface runoff from field pasture plots after application of dairy manure as compared to field plots that had not received manure, 2) to compare the standard method for FC and *E. coli* analysis with a new method (IDEXX QuantiTray), 3) To develop advanced techniques using molecular biology to differentiate *E. coli* from dairy waste vs other waste sources.

2. Methods

Nine field plots were constructed in bermuda grass pasture with Tangi silt loam soils with an average slope of 3%. Dairy animals had not grazed on pasture at this site for over six years and did not graze at the site for the duration of the research project. Impervious sheet metal borders were buried to a depth of approximately 15 cm (6 in) around each plot to divert runoff from surrounding pastures. A runoff collection trough was installed at the bottom of each plot.

Three dairy manure application types were used for the study. For the first type, the plots received dairy manure applied as deposits to simulate natural deposition of manure from cows. For the second type, the plots received dairy manure distributed evenly over the area of the plot to simulate land application of waste. A dairy manure loading rate of 1,200 kg/ha, representing approximately 1.5 animals/ha, was used for both treatments. In the control plots, inorganic fertilizer was applied. Rainfall simulations were conducted using a set rainfall intensity of 6.4 cm/hr (2.5 in/hr) applied with a TLALOC 3000 Rainfall Simulator. Rainfall simulations were conducted on the day of manure application and approximately 3- to 7-day intervals after manure application.

3. Results and Discussion.

Preliminary results from the field research (Figure 1) indicate that FC counts in surface runoff from the plots with the distributed manure application method (Method 2) were higher than the counts from plots with the simulated natural deposition application by cows (Method 1) and the control plots (no manure application). FC counts increased after the initial rainfall simulation in many cases. The FC counts from the Method 1 plots were not significantly different from the control plots for many simulations. These results suggest that grazing of dairy cattle may not pose as substantial a threat to surface water quality as mechanical manure application, if the manure piles are not disturbed. FC counts in the simulated grazed plots were reduced to levels near the primary standard for primary contact recreation (400 cfu/100 mL) within 7 – 14 days. Manure application by distributed application may expose a greater surface area of manure to surface runoff, thus causing the elevated FC counts. Also, elevated FC counts are detected in the control plot runoff, which suggests that 'false' FC counts may be elevating these values. Complete statistical analyses of the data collected thus far are being conducted, with more rainfall simulations planned for this summer.

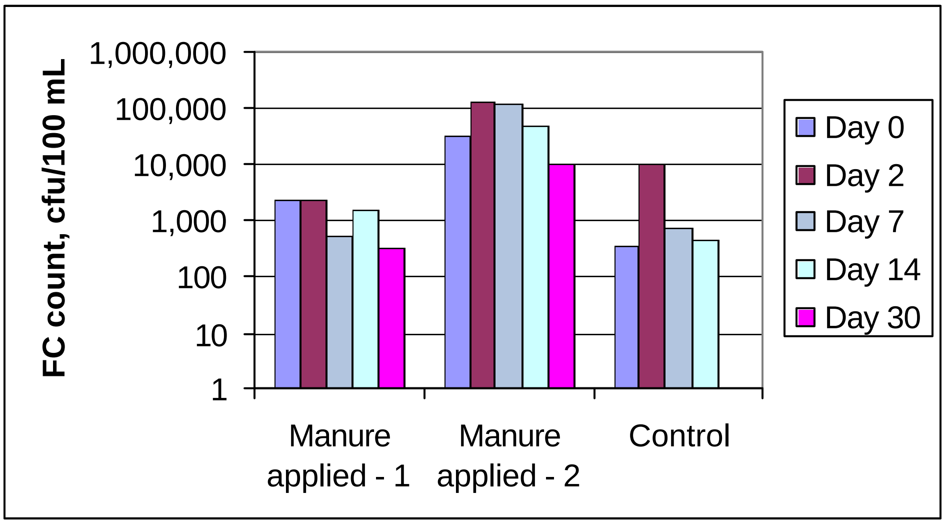


Figure 1: FC counts in surface runoff from field plots after rainfall simulation.

The microbial analysis of the water samples showed that the new technique, the IDEXX system, was not better than the standard plate count technique for determination of FC. A DNA 'fingerprinting' technique was investigated to attempt to differentiate *E. coli* from dairy waste vs other waste sources and from natural, background coliform bacteria. One technique, RAPD PCR, was reproducible in distinguishing *E. coli* found in dairy waste from those *E. coli* strains found in human waste. Research is continuing in the development of this procedure.

II. CURRENT RESEARCH

The goal of the current research is to develop and evaluate advanced biological treatment systems to effectively reduce the concentration of organic carbon, nutrients and fecal microorganisms in dairy wastewater. The specific objective is to compare the approved NRCS anaerobic lagoon design with a) two-stage, anaerobic/aerobic lagoon design, b) two-stage biological reactor system called the Anoxic/Aerobic (A/A) system, and c) constructed wetlands. Preliminary lab-scale results of the A/A system showed that ammonia-N was reduced 99.8%, total organic carbon was reduced 70%, and FC was reduced by one order of magnitude. The experimental lagoons, field-scale A/A system, and wetlands will be constructed at the Southeast Research Station this winter and spring.

Alfalfa Establishment and Management in Louisiana

Brad Venuto, Ed Twidwell, Chris Wildman, Jerry Simmons, Randall Riley, Catherine Coxe, and Mike McCormick

Although more than 23 million acres of alfalfa (*Medicago sativa* L.) are grown in the top 10 U.S. dairying states, very little acreage is grown in Louisiana. Weather-related harvest difficulties, establishment and stand persistence have limited its use in this region. With the advent of new baleage harvesting strategies, researchers at the LSU AgCenter decided to investigate the economic feasibility of producing alfalfa as an annual forage crop. In addition, the impact of harvest management on yield, quality and stand persistence was investigated.

Establishment: Successful alfalfa establishment depends on planning. Late fall plantings, mid-October through mid-November, are more successful than early spring plantings. Site preparation should begin as early as possible. Existing plant cover or previous crop should be removed by early August. Any re-growth, particularly from summer perennials, should be killed with an appropriate application of Glyphosate by mid-August. If the field has not been previously limed, dolomitic limestone should be applied according to soil test and incorporated with a tillage operation by early September or as soon as your mid-August herbicide application has had time to be effective. After initial site preparation, allow any weed seeds to germinate. These weeds seedlings can be killed in September (by disking) prior to final seedbed preparation.

Fertilizer should be incorporated prior to the last tillage operation. Phosphorus and potassium should be applied as recommended by soil test. In addition, it is very important that 20-30 lbs/acre of sulfur (S) and 2-3 lbs/acre of boron (B) be applied at this time. Use a pre-plant incorporated herbicide for weed control. EPTC (Eptam) 7EC is effective and should be applied at 2-4 lb a.i. per acre. Use a low rate on sandy soils and high rate on heavy soil. Incorporate IMMEDIATELY to 3- to 4-inch depth. Failure to incorporate will result in volatilization and the herbicide will be ineffective. Seeding rate should be 16 to 20 lbs of live seed per acre, depending upon seed bed preparation. Based on trials at the Southeast Research Station, Amerigraze 702 has shown promise in this area. Seed should be inoculated properly and planted no deeper than 1/4 to ½ inch deep. Planting seed too deep is a common cause of poor stand establishment. The seedbed should be roller packed after seeding to insure maximum seed/soil contact and moisture retention around the seed.

Post emergence weed control: Problems with weeds after planting can be controlled in various manners. Broadleaf weeds can be controlled with 2,4-DB (Butoxone, Butyrac) at 0.5 to 1.5 lb a.i. per acre. Weeds must be 3 inches or shorter! Grass weeds can be controlled by Sethoxydim (Poast). Apply when weeds are still small. Other choices are available, but these are the more common.

Harvest management:

The first spring harvest should be delayed long enough to allow the alfalfa plants to become well established. Too early a harvest at this time will set back the new stand considerably. First harvest will probably be in early April, depending on weather conditions. The recommended harvest interval should be no less than five weeks between cuttings. A shorter harvest interval will increase quality some, but yields will be reduced and stand life seriously jeopardized. For example, in the study summarized in the table below, none of the plots harvested at four-week intervals survived into a second year.

Harvest interval	**Protein, %**	**NDF, %**	**ADF, %**	**IVTD,%**	**RFV**	**TDN, %**	**NE_L, MCal/kg**
4 - wk	20.2	42	29.9	79.5	154	67	1.52
5 - wk	19.4	41.5	31.1	77.6	152	65	1.47
6 - wk	18.7	41.9	31.2	77.0	149	65	1.47

Fertility management: After first harvest, the field should be top dressed with P and K and an additional 20 lbs S and 2 lbs B (20 S and 2 B should be applied once annually). Additional applications of P and K can be made after subsequent harvests (not every harvest) depending on yield. Once established, fertilizer applications should be made to replace nutrients removed.

Field scale verification study: A 12-acre field was prepared as described above and planted in late November of 2002. The table indicates cutting interval, yield (tons hay equivalent), plant density, weed encroachment, and quality (dry matter, protein, and relative feed value) of the harvested alfalfa. All harvests were made as baleage (4 x 4.5 ft bales wrapped in 6 layers of stretch film). Costs for soil preparation (1 qt Round-Up and three diskings), seed, fertilizer and herbicide at planting were approximately $290/acre. First year fertilizer, pesticide, and harvest costs (10.6 wrapped bales per acre over 4 cuttings) were estimated to cost $209 per acre for a total first year direct cost of $499 per acre. Using an average alfalfa hay value of $150 per ton on 4.8 tons of alfalfa hay equivalent generates a first-year hay value of $720 per acre and an over direct cost return of about $221 per acre ($720-$499). Since a fifth cutting is anticipated in mid-October, first year returns should approach $300/acre. Further research is planned to evaluate stand persistence, forage quality, and economics of alfalfa production for baleage and grazing.

Field-scale Alfalfa Production and Quality Data (2003 growing season).

Harvest date	Harvest interval (days)	Yield (tons hay/acre)	Plants/ square ft.	Weeds/ square ft.	Dry matter, %	Protein, %	Relative Feed Value
April 15	45	1.05	8.0	0.9	42.3	18.6	164
May 30	45	1.40	7.1	2.7	71.8	19.7	119
July 23	53	1.40	5.6	1.2	61.3	16.4	98
Sept 11	50	0.95	6.0	4.0	59.7	13.7	121
Avg.	**48**	**1.2**	**6.8**	**2.2**	**58.8**	**17.1**	**126**

Seeding Rate Effect on Annual Ryegrass Production

Brad Venuto, Daren Redfearn, W.D. Pitman and M.W. Alison

Introduction. Annual ryegrass (*Lolium multiflorum* Lam.) is a primary forage resource for livestock producers throughout Louisiana during the winter growing season. It is important for livestock producers to begin grazing annual ryegrass as early as possible, and any management practices maximizing early-season production could be beneficial.

Procedures. To assess the impact of seeding rate on subsequent yield, yield distribution, quality, seedling density, and end-of-season plant and tiller density, a two-year study was initiated at the Southeast Research Station and three other LSU AgCenter research stations, Idlewild, Macon Ridge and Rosepine. Three annual ryegrass cultivars (Abundant, Jackson and Rustmaster), varying in seed size, were established at four seeding rates based on pure live seed (PLS) rates of 37, 74, 111 and 148 PLS ft $^{-2}$. Since seeding rate is normally based on lbs/acre, the PLS rates are shown converted in Table 1.

Table 1. Seeding rate in lbs/acre for three annual ryegrass cultivars established at four pure live seed rates.

		Pure live seed per square foot			
Cultivar	**Year**	**37**	**74**	**111**	**148**
Abundant	2000	16	32	48	64
	2001	15	30	45	60
Rustmaster	2000	12	24	36	48
	2001	9	18	27	36
Jackson	2000	10	20	30	40
	2001	10	20	30	40

Results/Conclusions. There was little or no advantage in total forage production from increasing seeding rates beyond 74 PLS ft^{-2} (Table 2). This is equivalent to an average seeding rate (across all cultivars) of 24 lbs/acre. However, first-harvest yields increased from 320 to 830 lbs/acre as seeding rate increased from 37 to 148 PLS ft^{-2} (Table 3). The forage quality parameters, crude protein (CP), neutral detergent fiber (NDF), and in-vitro true digestibility (IVTD), were not affected by seeding rate.

Table 2. Total dry matter forage production across all three annual ryegrass cultivars and four test locations in Louisiana.

PLS	(lbs seed/acre)	Year 2000	Year 2001
		lbs of forage per acre	
37	(12)	7700	6500
74	(24)	8300	7100
111	(36)	8500	7200
148	(48)	8000	7200

Table 3. Total first harvest dry matter forage production across all three annual ryegrass cultivars and four test locations in Louisiana.

PLS	(lbs seed/acre)	2000/2001
		lbs of forage per acre
37	(12)	320
74	(24)	550
111	(36)	710
148	(48)	830

Seedling density and end-of -season plant numbers increased as seeding rate increased (Table 4). However, stems per square foot did not increase beyond 111 PLS ft^{-2}. This data indicates that there were fewer plants per square foot at the end of the growing season at the lower PLS rates, but these plants tended to have more tillers. This compensatory tillering explains the lack of a significant overall season yield advantage for the higher seeding rates.

These results indicate that first-harvest yield can be increased by planting at higher seeding rates, but total yields will not be increased at the highest rates. For the producer needing extra early season forage, planting at a higher seed rate may be justified. However, the producer should be aware that seed size varies considerably, particularly between larger seeded tetraploids and the smaller seeded diploid cultivars. To achieve a PLS seeding rate of 111 seed per square foot in this study, 48 lbs/acre of seed was necessary for Abundant while 30 lbs/acre gave the same PLS rate for Jackson.

Producers should also consider this data before replanting a poor fall stand. Replanting in late fall will minimizes or negate any opportunity for early-season forage production that might have been achieved with a higher number of seedlings. The existing stand, although poor, may have enough plants to produce total season forage, through compensatory growth and tillering, comparable to that of any reseeded stand.

Bermudagrass Variety Field Trial

Daren Redfearn, Brad Venuto and Diana Corkern

Procedures: In July 1997 twenty-six bermudagrass varieties were planted in a randomized block design to compare yield of each variety. In May 1998 most plots reached 70% or greater bermudagrass stand and were harvested for the first time. By the end of 1999 six entries were eliminated; Tanberg, Tifton 78, sprigged Common, sprigged Tierra Verde, sprigged ED5 and sprigged CD90160. When the trial was terminated following five harvests in 2001, eight additional varieties had been eliminated because of poor stands: Lancaster, Murphy, Poplarville, Poplarville 2, seeded Common, seeded Tierra Verde, seeded ED5, and SERS, leaving 12 bermudagrass varieties extending the length of the four year test.

Results and Conclusions: Four-year yield results show that Tifton 85 and Sumrall produce significantly more dry forage per year than the other varieties, while Gillihan, seeded CD90160 and sprigged LD3 produced significantly less. The 1999 growing season produced significantly more dry forage, followed by the 2000, 2001 and 1998 seasons, respectively.

Table 1. Four-year dry yields of bermudagrass varieties grown at the Southeast Research Station, Franklinton, La. 1998-2001.

	Year				
Entry	1998	1999	2000	2001	Avg mean
Tifton 85	18,580	26,654	22,790	20,369	22,099
Sumrall	18,581	25,463	17,614	16,121	19,445
Lott	14,810	26,345	15,624	13,859	17,659
Coastal	12,546	20,215	20,194	16,278	17,308
Alicia	12,536	21,261	16,366	17,350	16,878
Poplarville 1E	15,824	22,619	15,737	13,271	16,863
Russell	12,106	21,529	15,636	15,146	16,105
Tifton 44	12,432	18,929	15,210	16,167	15,685
Hardie	13,355	21,209	14,687	12,112	15,341
Gillihan	10,579	19,403	14,588	16,198	15,192
CD90160, seeded	10,559	16,285	13,593	9,503	12,485
LD3	8,587	13,450	10,578	11,664	11,070
Mean	13,375[c]	21,114[a]	16,051[b]	14,837[bc]	16,344
C.V., %					14
LSD (0.05)					1,634

Performance of Winter Annual Forage Crops at the Southeast Research Station (2002-2003), Franklinton, La.

Brad Venuto and Diana Corkern

Introduction. Annual forages are recommended for grazing, green chop, hay, and silage production in Louisiana. Each year scientists of the Louisiana State University Agricultural Center conduct performance trials to evaluate the forage production of annual ryegrass, cereal rye, oat, wheat, pearl millet, forage sorghum and sorghum/sudangrass varieties. Trials are conducted at various LSU AgCenter research stations to provide information on the performance of varieties under varying soil and climatic conditions. Data presented in this report are from the Southeast Research Station plot tests. For performance at other locations refer to LAES Research Summary No. 15, "Performance of Cool-season Annual Forage Crops in Louisiana, 2002-2003."

Testing Procedures. The annual forage variety testing program is open to all commercially available varieties and advanced experimental lines of annual ryegrass, cereal rye, oats, wheat, pearl millet, forage sorghum and sorghum/sudangrass developed by either public or private plant breeding programs. The trials are managed using production practices recommended by the Louisiana Cooperative Extension Service (LCES) for each species, with soil amendments applied as indicated by soil test and herbicides used as appropriate.

The trials are conducted in randomized complete-block designs with three to four replications. Plots of each species are cut to a 2- to 4-inch stubble height when 8 to 12 inches tall. Cumulative forage yield data are combined over one to three years and analyzed by analysis of variance procedures to evaluate variety yields. The least significant difference (LSD) value represents the minimum amount by which variety yields must differ to be considered statistically different from one another. If differences are not detected among varieties, the LSD value is not presented.

ANNUAL RYEGRASS

Annual ryegrass (*Lolium multiflorum*) is recommended for use as a high quality winter grazing, hay, or silage crop on most soils. Annual ryegrass plots were seeded at the rate of 30 lbs/acre into a prepared seedbed. Phosphorus (P) and potassium (K) fertilizer was applied according to soil test recommendations made by the LCES. Total nitrogen (N) applied was 250 lbs/acre in multiple applications at planting and after 2nd and 4th harvest. The ryegrass trial was planted October 18, 2003 at the Southeast Research Station into a Tangi silt loam.

Results of annual ryegrass trials

Recommended varieties for 2003 are Gulf, Jackson, Jumbo, Marshall, Passerel Plus, Ribeye, TAM 90, Beefbuilder III, Prine, Brigadier, and Ed. Lone Star is a promising variety for 2003.

Table 1 2002-2003 dry matter yields of ryegrass entries for the Southeast Research Station, Franklinton, La.

Brand/Variety	Harvest Dates				Total Yield
	1/6/03	2/18/03	3/13/03	4/22/03	
	- - - - - - - - - - - - - lbs dry forage/acre - - - - - - - - - - - - -				
Bar 9 Tam	1184	1234	4703	4053	11173
Beefbuilder III	518	1879	3813	4073	10283
FLX2002(DRU)LRCT	104	1442	4314	3430	9291
Brigadier	294	897	5164	2534	8890
ME94	686	1173	3747	3119	8725
Passerel Plus	638	709	3604	3506	8456
Ribeye	265	362	3415	4097	8139
Ed	426	773	3654	3066	7919
FLX2002(NEW2)LRCT	197	699	3386	3583	7864
Marshall	472	451	4131	2708	7762
Tam 90	447	1115	3025	3149	7736
Prine	592	982	2963	3181	7719
ORE-TARX	538	666	3456	2705	7365
FLX2002(NEW)4XMR	313	492	3849	2440	7094
FLX2002(LA3)LRCT	98	936	3471	2490	6996
Gulf	823	586	3388	1946	6743
WD-40	199	543	3085	2697	6524
Jackson	578	221	3275	2223	6297
Joe-1	279	532	3448	1982	6241
Jumbo	170	558	3451	2037	6216
Southern Star	282	361	3044	2308	5995
WMN97	121	273	3374	2176	5943
Lone Star	375	256	3142	1565	5338
SCH-5	296	489	2042	1787	4614
Mean	**413**	**735**	**3539**	**2786**	**7472**
CV%	**81.6**	**65.5**	**8.5**	**7.3**	**9.9**
LSD (0.05)	**554**	**791**	**493**	**333**	**1216**

Table. 2 Mean dry matter yields of ryegrass varieties grown at the Southeast Research Station, Franklinton, La. during three growing seasons, 2000-2003.

	Year			3-yr.
Brand/Variety	**2000-01**	**2001-02**	**2002-03**	**mean**
	- - - - - - - - - - - - - lbs dry forage/acre - - - - - - - - - - - - -			
Beefbuilder III	9444	7746	10,283	9158
Brigadier	9499	7247	8890	8546
Prine	9440	7767	7719	8309
ME94	9135	6934	8726	8265
Ed	9268	7506	7919	8231
Passerel Plus	8964	7192	8456	8204
Marshall	8823	7925	7762	8170
Gulf	8989	8456	6743	8062
Jumbo	9904	7969	6216	8030
Ribeye	8914	6682	8139	7912
Tam 90	8587	6412	7736	7579
WMN97	9136	6154	5944	7078
Jackson	8285	6368	6297	6983
Mean	**9107[a]**	**7258[a]**	**7756[a]**	**8041**
CV%				**12**
LSD (0.05)				**872**

CEREAL RYE

Cereal rye (*Secale cereale*) is more cold tolerant and generally produces more forage during late fall and early winter than does annual ryegrass. Cereal rye is recommended either alone or in mixtures with annual ryegrass for use as a winter grazing and/or spring hay crop on most soils and is more tolerant of soil acidity than ryegrass or other small-grain species. Plots were seeded as pure stands at the rate of 90 lbs/acre into a prepared seedbed. Phosphorus (P) and potassium (K) fertilizer was applied according to soil test recommendations made by the LCES. Total nitrogen (N) applied was 250 lbs/acre in multiple applications at planting and post harvest. Cereal rye was planted October 18, 2003, at the Southeast Research Station into a Tango silt loam soil.

Results of cereal rye trials

Recommended varieties for 2003 are Bates, Elbon, Oklon, Maton, and Wintergrazer 70.

Table 3. 2000-2003 dry matter yields of cereal rye entries for the Southeast Research Station, Franklinton, La.

Brand/Variety	Year 2000-01	2001-02	2002-03	3-yr. mean
	- - - - - - - - - - - - - lbs dry forage/acre		- - - - - - - - - - - - -	
Elbon	6661	5513	4509	5561
Bates	6868	5341	4421	5543
Wintergrazer 70	6644	5303	4595	5513
Maton	6835	4791	4072	5232
Oklon	6925	4413	4258	5199
Mean	**6786[a]**	**5072[b]**	**4371[c]**	**5410**
CV%				**17**
LSD (0.05)				**NS**

Table 4. 2002-2003 dry matter yields of cereal rye entries for the Southeast Research Station, Franklinton, La.

Brand/Variety	Harvest Dates 1/7/03	2/18/03	3/13/03	Total Yield
	- - - - - - - - - - - - - lbs dry forage/acre		- - - - - - - - - - - - -	
NF65	894	928	3190	5012
NF1	615	700	3297	4612
XR 9909	535	758	3309	4602
Wintergrazer 70	522	763	3310	4595
SPI	612	700	3245	4557
Elbon	151	749	3609	4509
Bates	259	448	3714	4421
NF28	830	658	2867	4354
FLNF94 Sel	307	627	3416	4349
Oklon	914	715	2630	4258
FL Bates Sel	342	995	2788	4125
XR 9910	357	439	3282	4078
Maton	230	371	3471	4072
FLPL97P20	685	869	2248	3802
XR 9908	374	525	2835	3734
Mean	**508**	**683**	**3147**	**4339**
CV%	**59.9**	**38.7**	**12.4**	**18.5**
LSD (0.05)	**ns**	**ns**	**652**	**ns**

OATS

Oats (*Avena sativa*) produce high quality forage during the early winter season. Plots were planted as pure stands at the rate of 100 lbs/acre into a prepared seedbed. Phosphorus (P) and potassium (K) fertilizer was applied at all locations according to soil test recommendations made by the Louisiana Cooperative Extension Service. Total nitrogen (N) applied was 250 lbs/acre in multiple applications at planting and post harvest. At the Southeast Research Station, the oat variety trial was planted October 18, 2003, into a Tangi silt loam soil.

Table 5. 2002-2003 dry matter yields of oat entries for the Southeast Research Station, Franklinton, La.

	Harvest Dates			**Total**
Brand/Variety	**1/7/03**	**2/20/03**	**3/13/03**	**Yield**
	- - - - - - - - - - - - - lbs dry forage/acre	- - - - - - - - - - - - -		
Horizon 474	530	447	4144	5121
LA9891IBI-49	292	1268	3446	5006
LA966BIB-151-1	815	1034	3039	4888
LA9810IBI-58	977	656	3082	4716
Harrison	285	991	3258	4534
LA9821IBI-26	515	328	3682	4525
FL9708-P37	397	372	3729	4498
LA9533D36-5	361	1212	2655	4228
Horizon 314	146	543	3512	4201
LA966BIB119-1	644	472	3045	4162
LA9339E45	557	397	2762	3717
TX01C5RHSell	160	479	2998	3637
Mean	**473**	**683**	**3279**	**4436**
CV%	**32.9**	**32.3**	**7.0**	**9.1**
LSD (0.05)	**264**	**374**	**387**	**687**

Appendix A. Originating Agencies for Annual Ryegrass Varieties Entered in 2002-2003 Variety Tests

Brand/Variety	Originating Agency
FLX2002(NEW)4XMR, FLX2002 (NEW2)LRCT, FLX2002(LA3)LRCT, FLX2002(DRU)LRCT	University of Florida, P.O. Box 110500, 304 Newell Hall, Gainesville, FL 32611-0500

Brand/Variety	Originating Agency
Gulf	Circle T Fertilizer & Seed Co., 1106 16th Ave., Franklinton, LA 70438
Ribeye, Jumbo	Barenbrug USA, P.O. Box 239, 33477 Hwy 99E, Tangent, OR 97389
Jackson, Marshall, ME94, WMN 97	The Wax Company, LLC, P.O. Box 60, Amory, MS 38821
Bar 9 Tam	Texas A & M Research and Extension Center, P. O. Box 200, Overton, TX 75684
[illegible]	[illegible]
Beefbuilder III, Southern Star	Forbes Seed & Grain, P.O. Box 85, Junction City, OR 97448
[illegible]	[illegible]
Ed	Smith Seed Services, P.O. Box 288, 26890 Powerline Rd., Halsey, OR 97348
Lone Star	Grassland Oregon, P.O. Box 21630, Keizer, OR 97307
SCH-5, ORE-TARX, WD-40, Joe-1	Oregro Seeds, Inc., P.O. Box 10, Shedd, OR 97377

Appendix A. Originating Agencies for Cereal Rye Varieties Entered in 2002-2003 Variety Tests

Brand/Variety	Originating Agency
Elbon, Maton, Oklon, Bates, NF1, NF65, NF28	The Samuel Roberts Noble Foundation, Inc., P.O. Box 2180, Ardmore, OK 73402

Wintergrazer 70, SPI	Pennington Seed, Inc., P.O. Box 290, Madison, GA 30650
XR 9908, XR 9909, XR 9910	Seed Resource, P. O. Box 326, 505 East Service Rd., Tulia, TX 79088
FLP97P20, FL Bates Sel., FLNF94 Sel.	North Florida Research & Educ. Center, University of Florida, 155 Research Rd, Quincy, FL 32351

Appendix A. Originating Agencies for Oat Varieties Entered in 2002-2003 Variety Tests

Brand/Variety	Originating Agency
FL9708-P37, Horizon 314, Horizon 474	North Florida Research & Educ. Center, University of Florida, 155 Research Rd, Quincy, FL 32351
Harrison	Arkansas County Seed Co., Inc., P.O. Box 43, Stuttgart, AR 72160
Louisiana Experimentals (LA's)	Agronomy Department, LSU AgCenter, Baton Rouge, LA 70803
TX01C5RHSell	Texas A & M Research and Extension Center, P. O. Box 200, Overton, TX 75684

Forage Quality Analysis of Producer Samples Submitted to the Southeast Research Station Forage Quality Laboratory, 2002

Randy Walz, Jerry Ward, and Mike McCormick

Introduction. In 2002 more than 2000 producer samples were submitted to the Forage Quality Laboratory at the Southeast Research Station (SERS) for nutrient concentration analysis. The average concentrations of protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), copper (Cu), zinc (Zn), and manganese (Mn) for selected forages are listed in Tables 1-3. The purpose of this summary is to provide producers, educators, and consultants with information on forage quality and how it relates to plant species, stage of harvest, and storage method.

Procedures: Forage samples were received via mail and walk-in. Upon arrival, samples were logged in and wet samples such as pasture and silage were placed in a drying oven for a minimum of 48 hours. After drying, representative samples were finely ground (1 mm screen) and stored in plastic vials. Analysis of all organic components (protein, ADF, and NDF) were conducted via near infrared spectroscopic (NIRS) analyses. Wet chemistry methods were used for all mineral analyses.

Results/Conclusions: An examination of protein values in Table 1 reveals that legumes, such as alfalfa and clovers, generally have highest protein levels (over 20%). The only other forage with an average protein content above 20% was ryegrass pasture. Not only was ryegrass pasture the highest non-legume in protein, it also had the lowest ADF concentration of all forages tested. Since ADF level and digestibility are negatively correlated, TDN was highest for the ryegrass pasture. High protein and energy values for ryegrass pasture compared to summer perennial pastures and hay likely explain large spikes in milk production and calf growth observed when cattle are introduced to winter pastures. Generally, ensiled forages were higher in nutritive value than hays. For example, ryegrass baleage was, on the average, three units higher in protein than ryegrass hay. Much of the forage stored as ryegrass baleage was harvested in April. Ryegrass hay was mostly harvested in May at a later stage of maturity.

Considerable variation also exits in the mineral concentrations among forages (Tables 2 and 3). Calcium values ranged from a high of 1.33% for clover to a low of 0.14% for corn silage. Phosphorus concentrations ranged less than calcium, with highest values being recorded for ryegrass and clover pastures. Phosphorus levels in soil and ground water are important criteria in evaluating on-farm nutrient management. Potassium concentrations were highest in ryegrass and clover samples. Feeding forages high in K may have positive effects for milk cows under heat stress, but may have adverse effects when fed to dairy cows pre-calving. Generally, the trace minerals copper and zinc were present in low quantities, while manganese was quite abundant in many forages evaluated. Forage mineral concentrations should be considered when formulating mineral supplements and feeds for beef and dairy cattle. Adjusting mineral supplements for forage mineral concentrations may be advantageous in terms of economic value, animal response, and environmental stewardship.

Table 1. Nutrient Concentration of Selected Forages (2002), LSU AgCenter Southeast Research Station Forage Quality Lab.[1]

Forage	Observ	Avg CP	SD CP	Avg ADF	SD	Avg NDF	SD	Avg TDN	SD
Alfalfa hay	53	21.68	3.50	29.86	5.13	37.76	6.90	66.73	5.49
Alfalfa baleage	4	13.00	1.21	41.11	3.69	54.86	4.11	54.71	3.95
Bahiagrass pasture	11	14.11	2.96	36.38	5.11	63.45	6.59	56.15	5.02

Bahiagrass hay	130	8.50	2.37	41.96	3.86	74.40	4.85	50.06	3.69
Bahiagrass baleage	10	10.57	1.79	43.19	2.37	72.75	6.08	49.40	2.34
Bermudagrass pasture	28	16.03	4.97	33.78	3.73	66.68	5.57	58.75	4.06
Bermudagrass hay	352	10.27	2.62	38.21	3.38	74.46	3.68	53.74	3.26
Bermudagrass silage	3	9.03	4.70	42.92	5.87	76.93	4.00	49.39	6.10
Bermudagrass baleage	19	10.22	3.37	38.48	10.17	69.28	17.98	53.62	8.98
Clover pasture	4	27.03	0.52	25.11	0.41	28.62	2.311	71.81	0.44
Clover hay	7	15.75	5.57	37.03	7.80	46.18	9.62	59.07	8.34
Corn silage	193	8.31	2.25	26.82	7.50	43.66	12.13	67.71	5.62
Crabgrass hay	10	8.97	2.65	43.19	6.17	76.83	4.72	49.04	5.88
Crabgrass silage	4	10.36	1.87	40.75	3.65	71.14	9.95	51.58	3.44
Crabgrass baleage	16	12.11	3.31	40.85	3.83	71.90	7.01	51.78	3.94
Forage sorghum silage	21	9.32	1.81	42.87	5.37	70.72	9.30	47.77	4.45
Forage sorghum	5	9.49	5.32	27.64	15.51	42.81	23.97	60.41	12.88
Ryegrass pasture	39	24.60	6.98	23.23	4.74	37.55	6.50	75.92	5.33
Ryegrass hay	57	10.70	3.30	40.98	4.90	67.86	5.67	56.84	4.71
Ryegrass silage	64	13.03	3.80	40.98	6.25	60.81	10.98	57.87	5.96
Ryegrass baleage	209	13.93	3.76	36.92	6.00	56.93	8.64	61.41	5.68
Ryegrass greenchop	12	15.63	5.11	34.74	11.18	55.35	17.58	63.72	7.46

[1]Analyses presented on dry matter basis. Avg = average, SD = standard deviation, Observ. = number of samples analyzed, CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber, and TDN = total digestible nutrients.

Table 2. Macromineral Concentrations of Selected Forages (2002), LSU AgCenter Southeast Research Station Forage Quality Lab.[1]

	Observ.	Avg Ca	SD Ca	Avg P	SD P	Avg Mg	SD Mg	Avg K	SD K
Alfalfa hay	18	1.27	0.17	0.24	0.03	0.38	0.08	2.06	0.84
Bahiagrass pasture	11	0.37	0.06	0.25	0.08	0.22	0.05	1.20	0.54
Bahiagrass hay	57	0.29	0.10	0.21	0.07	0.29	0.10	1.04	0.80
Bahiagrass baleage	3	0.25	0.05	0.22	0.06	0.31	0.08	1.30	0.47
Bermudagrass pasture	18	0.39	0.15	0.27	0.07	0.19	0.04	1.43	0.55
Bermudagrass hay	126	0.28	0.08	0.24	0.06	0.17	0.05	1.27	0.70
Bermudagrass baleage	8	0.44	0.06	0.26	0.08	0.27	0.07	0.93	0.78
Clover pasture	4	1.33	0.14	0.38	0.05	0.40	0.03	3.28	0.86
Clover hay	5	1.42	0.74	0.33	0.17	0.41	0.14	2.95	0.67
Corn silage	32	0.14	0.03	0.20	0.05	0.17	0.05	0.63	0.46
Crabgrass hay	5	0.30	0.07	0.27	0.09	0.45	0.09	1.63	0.85
Crabgrass baleage	8	0.31	0.18	0.25	0.05	0.45	0.09	1.61	0.83
Forage sorghum silage	15	0.28	0.23	0.10	0.08	0.15	0.15	0.57	0.46
Ryegrass pasture	35	0.39	0.16	0.40	0.08	0.22	0.04	3.03	1.01
Ryegrass hay	19	0.38	0.11	0.25	0.10	0.24	0.10	1.76	1.18
Ryegrass haylage	14	0.51	0.13	0.22	0.08	0.22	0.10	1.73	1.01
Ryegrass baleage	105	0.45	0.10	0.36	0.13	0.24	0.05	2.59	1.18

[1]Analyses presented on dry matter basis. Avg = average, SD = standard deviation, Observ. = number of samples analyzed, Ca = calcium, P = phosphorus, Mg = magnesium, and K = potassium.

Table 3. Micronutrient Concentrations of Selected Forages (2002), LSU AgCenter Southeast Research Station Forage Quality Lab.[1]

Forages	Observ.	Avg Cu	SD	Avg Zn	SD Zn	Avg Mn	SD Mn
Alfalfa hay	18	10.15	4.64	21.87	6.15	56.09	18.39
Bahiagrass pasture	11	10.44	6.96	37.14	19.91	340.27	176.54
Bahiagrass hay	57	7.75	9.25	25.77	12.79	327.27	168.78
Bahiagrass baleage	3	7	2.64	28.33	10.01	568	536.72
Bermudagrass pasture	18	7.26	2.43	37.78	6.06	171.20	163.52
Bermudagrass hay	126	7.05	7.07	30.56	14.53	141.15	84.69
Bermudagrass baleage	8	8.12	2.99	44.87	14.01	166.5	33.66
Clover pasture	4	10	4.96	66.25	48.58	56.75	30.36
Clover hay	5	6.76	3.72	54.37	44.08	75.31	19.78
Corn silage	32	4.31	2.44	21.65	8.13	76.71	37.99
Crabgrass hay	5	13.04	5.61	37.18	10.54	216.69	161.53
Crabgrass baleage	8	7.75	2.18	53.5	14.87	309	86.43
Forage sorghum silage	15	8.93	3.80	24	9.81	92.46	80.03
Ryegrass pasture	35	13.17	12.26	45.77	23.50	267.31	176.50
Ryegrass hay	19	6.66	5.54	26.90	8.18	259.27	199.83
Ryegrass haylage	14	7.07	6.04	59.78	98.83	349.57	213.06
Ryegrass baleage	105	10.37	5.53	39.41	13.46	257.05	140.61

[1]Values reported as part per million (ppm), Observ. = number samples analyzed, Avg = average, SD = standard deviation, Cu = copper, Zn = zinc, Mn = manganese.