Evaluation of Beef Cattle Winter Feeding Systems in the Southeast
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Summary
A study was conducted to compare beef cattle winter feeding systems in terms of animal performance, forage production and cost per pound of weight gained. Three winter feeding systems were compared: 1) bahiagrass hay fed ad libitum on a dormant bahiagrass pasture and supplemented with 1% (as fed, 89% dry matter [DM]) of BW/d fed 3 times/wk (Monday, Wednesday and Friday) with a 50:50 mixture of corn gluten feed and soybean hulls, 2) grazing winter pasture comprised of triticale/ryegrass blend, 3) grazing a winter pasture comprised of rye/ryegrass blend. Twelve 3-ac pastures and 48 crossbred heifers were used in the 84-d study. Herbage mass production was greatest for the rye/ryegrass blend (5,915 lb of DM/ac) when compared with triticale + ryegrass pastures (4,504 lb of DM/ac); however, average daily gain (ADG) was greatest for heifers grazing triticale + ryegrass (1.57 lb/d), followed by supplemented heifers (1.18 lb/d), and heifers grazing rye + ryegrass (0.88 lb/d). In terms of cost of gain, triticale + ryegrass showed a significant advantage when compared to the other treatments, having the lowest total cost of weight gain ($1.06/lb of BW gained) followed by supplemented heifers ($1.84/lb of BW gained), and heifers grazing rye + ryegrass ($1.99/lb of BW gained). The largest cost in a beef cattle operation continues to be the winter feeding, but advancements in terms of forage varieties and management, such as grazing a blend of triticale and ryegrass, may provide a viable alternative to help reduce this cost.

Introduction
The profitability of beef production is as many other production systems, a function of a balance between inputs and outputs. Outputs can be more easily defined than inputs and can be simplified as pounds of beef sold in one way or another: carcass, replacement heifers, yearlings, weaned calves. However inputs can be more challenging to define and vary greatly with different production systems. In addition, inputs can be often difficult to measure, such as labor cost (especially when we consider our own time, which is often not accounted for), fertilizer savings due to grazing, and opportunity cost among others.

In the current scenario of volatility in fuel, grain and fertilizer prices, it is not surprising that the focus of the beef industry has been turning to the inputs side of the equation. Several strategies have been developed to attempt to mitigate the ever-rising costs of production and we may be experiencing a shift in paradigms in the beef industry. The increased use of forage varieties that produce well under drought conditions or under reduced soil fertility is proof of that change in paradigms. The suitability of rye and triticale either as a monoculture or in blends with ryegrass as annual winter pastures has been evaluated for its forage production potential in recent years (Myer et al., 2009, 2011).

The objective of this study was to compare beef cattle winter feeding systems in the southeastern U.S. in terms of animal performance, forage production and cost per pound of weight gained.

Materials and Methods
The study was conducted at the North Florida Research and Education Center in Marianna, FL, during November 9 of 2010 to April 20 of 2011. A total of 48 crossbred heifers (734 ± 34 lb) and 12 dormant bahiagrass pastures (3 ac each) were utilized in a randomized block design with 3 treatments and 2 blocks (North and South). Each
pasture containing a total of 4 heifers served as the experimental unit for the study and a total of 4 pastures per treatment were used. Experimental treatments were:

1. **SUP** = Heifers received ad libitum access to bahiagrass hay plus a supplement of 50:50 mixture of soybean hulls/corn gluten feed pellets fed 3 times/week (Monday, Wednesday, Friday) at a rate of 1% (as fed, 89% DM) of their body weight/d

2. **T+RG** = Heifers continuously grazed a pasture planted with 85 lb/ac of Trical 342 triticale + 15 lb/ac of ryegrass (cv. Diamond R).

3. **R+RG** = Heifers continuously grazed a pasture planted with 70 lb/ac of FL401 rye + 15 lb/ac of ryegrass (cv. Diamond R).

All winter grazing pastures were planted on November 9 and 10, 2010 directly into a dormant bahiagrass sod using a no-till planter and were fertilized on December 2, 2010 with 50 lb/ac of N (NH₄NO₃) and 20 lb/ac of S and again on January 4, 2011 with 50 lb/ac of N (NH₄NO₃) and 10 lb/ac of S.

Heifers started grazing on January 26, 2011 (d 0 of the study) after obtaining an initial shrunk body weight (BW), when pastures reached 8 to 10 inches in height, and the study ended on April 20, 2011 (d 84). Heifers were individually weighed every 28 d after a minimum of 16 h fast (no feed/pasture or water) and at this time blood samples were obtained from jugular venipuncture in 10-mL evacuated tubes containing sodium heparin to be analyzed for blood urea nitrogen (BUN). Blood samples were placed on ice following collection, and centrifuged for 18 min at 4,000 × g at 4°C. After centrifugation, plasma was transferred into polypropylene vials (12 mm × 75 mm; Fisherbrand; Thermo Fisher Scientific Inc., Waltham, MA) and stored at -20°C until analysis. The analysis of BUN was conducted at the UF-NFREC laboratories using a QuantiChrom™ Urea Assay Kit (DIUR-500; BioAssay Systems, Hayward, CA).

Heifer average daily weight gain (ADG) was computed both for each 28-d weight interval and cumulative from d 0 to each weight date.

Every 28-d forage samples were obtained from each pasture by grass clippings of a 0.25-m² surface. A total of 3 exclusion cages (1 m²) were placed in each of the winter forage pastures and samples were taking inside the cage and outside the cage (but near the cage) to determine herbage mass (HM) and HM accumulation rate (HAR). All exclusion cages were rotated to different places in the pasture every 28 d after samples were collected. In addition, one hand-pluck sample per pasture was collected in each 28-d period to be analyzed for nutritive value. Samples for HM and HAR were dried at 100°C for 48 h, while samples for nutritive value were dried at 55°C for 72 h. To calculate HAR, the following formula was used:

\[
\text{HAR (lb DM/ac/d)} = \frac{(\text{HMi} - \text{HMo})}{28}
\]

Where: HMi = herbage mass (in lb dry matter [DM]/ac) measured inside the cage at the end of the 28-d period, and HMo = herbage mass (in lb DM/ac) measured outside the cage at the beginning of the 28-d period.

For the economic analysis of cost of gain, variables included: supplement cost, labor cost of feeding, seed, fertilizer, fuel cost of feed deliveries, and hay cost. The seed cost of planting the triticale/ryegrass or rye/ryegrass pastures was $38/ac, while total fertilization costs were $110/ac. A fuel and labor cost of $35/ac were included for the pastures, to add up to a total cost of $183/ac of winter pasture planted. The cost of supplement and hay was $224/ton and $100/ton, respectively. A labor cost of $10/h, and a fuel cost of $12/d for hay and supplement delivery were included in the calculations.

Statistical analyses were conducted using the MIXED procedure of SAS (SAS Institute Inc., Cary, NC) for a generalized randomized block design using pasture as the experimental unit.

The model included the fixed effect of treatment and the random effect of block. Significance was declared at \( P < 0.05 \) and tendencies were
discussed when $0.05 < P < 0.10$. Blood urea nitrogen concentration and herbage mass accumulation rate were analyzed as repeated measures using the MIXED procedure of SAS and a first-order autoregressive covariate structure.

**Results**
The results of the study are shown in Tables 1 and 2, and Figures 1 and 2.

In terms of cost of gain, triticale + ryegrass showed a significant advantage over the other treatment options, with a total cost of gain of $1.06 per lb of BW gained. This largely due to the high ADG rates observed with triticale (Table 3 and Fig. 1) when compared with the other treatments. Supplementing heifers with 1% of their BW three times per week with a 50:50 mix of soy hulls and corn gluten feed pellets resulted in 1.2 lb/d or BW gain. This was not sufficient to dilute the high costs associated with feed purchase and delivery as well as hay feeding costs. Because of the poor BW gain in the heifers grazing rye + ryegrass, this treatment showed the highest total cost of gain ($1.99/lb).

It is noteworthy that by design, the stocking rate in the grazing treatments was sufficiently low to avoid restrictions on intake and thus in animal performance. The main differences in animal performance observed between grazing treatments are related to pasture quality rather than quantity. Follow up studies using the same annual winter pastures are underway to determine the effects of forage production on pasture carrying capacity using a variable stocking rate.

**Conclusion**
The cost of winter feeding continues to be the largest single cost in a beef cattle operation. Price volatility in grain byproducts, fertilizer and fuel has shifted the paradigm of production to place more emphasis on the inputs costs of an operation. Developments in terms of forage varieties have provided cattle producers with more options for winter forages. Blending winter forage species with different growing patterns can be an alternative to produce enough quality and quantity to support high rates of weight gain. Grazing a blend of triticale and ryegrass was shown to be a promising strategy to reduce the cost of winter feeding.

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**Literature Cited**

**Acknowledgments**
Appreciation is greatly expressed to Lamont and Leigh Ann Ennis from Southern Cattle Company for providing the heifers for this experiment, to Syngenta Cereals Inc. for the financial support, and to Foundation Seed Producers Inc. for providing the ryegrass seed. The assistance of David Thomas, Mark Foran, Pete Folsom, Olivia Helms, Don Jones, Mary Maddox, Butch Nowell, and Harvey Standland with data collection and laboratory analysis is gratefully acknowledged.
Table 1. Herbage mass accumulation rate (lb dry matter/ac) and total herbage mass produced during an 84-d winter feeding study conducted at NFREC, Marianna, FL.

<table>
<thead>
<tr>
<th>Day of study</th>
<th>Treatment</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>d 28</td>
<td>Triticale + ryegrass</td>
<td>36</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Rye + ryegrass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 56</td>
<td>Triticale + ryegrass</td>
<td>62</td>
<td>82</td>
</tr>
<tr>
<td>d 84</td>
<td>Triticale + ryegrass</td>
<td>63</td>
<td>86</td>
</tr>
<tr>
<td>Total herbage mass produced during the study, lb of dry matter/ac</td>
<td>4,504</td>
<td>5,915</td>
<td>944</td>
</tr>
</tbody>
</table>

1No day effect (P = 0.34), treatment effect (P = 0.14), or day × treatment interaction (P = 0.99).
285 lb/ac of Trical 342 triticale + 15 lb/ac of ryegrass (cv. Diamond R).
370 lb/ac of FL401 rye + 15 lb/ac of ryegrass (cv. Diamond R).
4Pooled standard error of treatment means, n = 4 pastures/treatment.

Table 2. Cumulative data of beef heifer performance under different winter feeding strategies in a study conducted at NFREC, Marianna, FL.

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial body weight, lb</td>
<td>Triticale + ryegrass1</td>
<td>736</td>
<td>735</td>
</tr>
<tr>
<td>Final body weight, lb</td>
<td>Rye + ryegrass2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average daily gain, lb</td>
<td>Supplemented control3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d 0 to 28</td>
<td>0.78</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>d 0 to 56</td>
<td>1.16</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>d 0 to end</td>
<td>1.57c</td>
<td>0.88a</td>
</tr>
</tbody>
</table>

a,b,cRow means with different superscripts differ, P < 0.05.
185 lb/ac of Trical 342 triticale + 15 lb/ac of ryegrass (cv. Diamond R).
270 lb/ac of FL401 rye + 15 lb/ac of ryegrass (cv. Diamond R).
3Heifers in the supplemented control treatment received a supplement of a 50:50 mixture of corn gluten feed:soybean hulls 1% of their body weight daily and ad libitum access to bahiagrass hay.
4Pooled standard error of treatment means, n = 4 pastures/treatment.
Figure 1. Monthly average daily gain (ADG) of heifers throughout the study, under different winter feeding strategies. Treatment x day interaction was observed ($P = 0.003$). T+RG = heifers grazing a pasture planted with 85 lb/ac of Trical 342 triticale + 15 lb/ac of ryegrass (cv. Diamond R); or 70 lb/ac of FL401 rye + 15 lb/ac of ryegrass (R+RG; cv. Diamond R); CON = Heifers supplemented with a 50:50 mixture of corn gluten feed:soybean hulls at 1% of their body weight daily and with ad libitum access to bahiagrass hay.