Effects of implant type and protein source on growth of steers grazing summer pasture

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ABSTRACT

A split-plot design was used to investigate the effects of implant type and protein source on performance of steers grazing summer pasture. Each year, 196 steers were stratified by arrival weight (216 ± 24 kg and 208 ± 23 kg for 2008 and 2009, respectively) and randomly allotted to 1 of 3 implant treatments in early June. Implant treatments were no implant (control), Ralgro (Schering-Plough Animal Health Corp., Union, NJ), and Component TE-G (Ivy Animal Health, Overland Park, KS). Supplement treatments were no supplement (control), cottonseed meal–based supplement (CSM; 33% CP), and dried distillers grains–based supplement (DDGS; 33% CP). Supplementation began in late July, and supplements were group fed, within pasture, 3 times each week at a rate of 0.95 kg/steer (DM basis). Supplementation increased BW and ADG by 12 and 0.16 kg, respectively (P < 0.05). Rate of BW gain was also improved by 0.05 kg (P < 0.05) for DDGS as compared with CSM, resulting in 2.67 versus 3.78 kg of supplement per kilogram of additional ADG for DDGS and CSM, respectively. Implantation increased final BW (P = 0.02) and improved ADG 8.1% (P = 0.01) during the first ~95 d, regardless of implant type. However, Component TE-G increased ADG (0.08 kg; P = 0.01) the final ~31 d of the grazing season as compared with control and Ralgro-implanted cattle. Responses to supplement and implant programs were additive. Supplementing DDGS and implanting with Component TE-G were the most economical programs during the 126-d grazing season.

Key words: grazing steer, implant, protein supplementation

INTRODUCTION

Stocker cattle are a major component of the beef industry in the southern Great Plains. Within this industry, there are several technologies available to operators to improve efficiency and increase profits. Some of these management strategies include, but are not limited to, implants, protein supplementation, and the inclusion of ionophores in mineral or feed supplements. Implants are one of the more profitable technologies available. Ralgro, an estrogenic implant (Schering-Plough Animal Health Corp., Union, NJ), is frequently used in the stocker industry. Kuhl (1997) reported that an average BW gain of 12 kg over an average grazing season of 120 d was seen with Ralgro implants. Ralgro uses a lactose carrier that has been deemed short acting (Istasse et al., 1988). Season-long grazing systems last 120 to 180 d, and Component TE-G (Ivy Animal Health, Overland Park, KS), a trenbolone acetate/estradiol implant for grazing cattle, has a suggested payout period of 120 d and might be more applicable to season-long grazing systems in the southern Great Plains. Season-long grazing systems also benefit from protein supplementation during late summer, when grasses are reaching maturity and quality is diminishing. During this time period forage intake and digestibility are hindered because of a deficiency in rumen ammonia-N (McCollum and Horn, 1990). The “Oklahoma Gold” program developed at Oklahoma State University was established on the basis that providing 0.45 kg/d of a high-protein supplement with an ionophore (38–40% CP) during late summer will improve performance of grazing steers approximately 0.23 to 0.27 kg/d. This program was established using oilseed
meals as a base commodity. In recent years these oilseed meals have increased in price relative to alternative protein sources such as dried distillers grains with solubles. On average, cottonseed meal has been $0.07 greater on a cost per unit of CP basis during the past 5 yr (USDA, 2010).

The hypothesis was that Component TE-G would enhance performance to a greater extent than Ralgro during late-season grazing and that dried distillers grains with solubles could be an effective replacement for traditional commodities used in supplements. Therefore, the objectives of this study were to evaluate the effects of implant type and protein source on performance of steers grazing summer pasture.

**MATERIALS AND METHODS**

**Study Site, Vegetation, and Stocking Rate**

This study was conducted during 2 consecutive years at the Oklahoma State University Crosstimbers-Bluestem Stocker Range, 11 km southwest of Stillwater, from late spring until early fall. Each year 12 pastures (106 ha) consisting primarily of introduced Old World bluestem (*Bothriochloa ischaemum*) and 3 tallgrass native range pastures (97 ha) consisting primarily of big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indiangrass (*Sorghastrum nutans*) were used to evaluate steer performance. In May of each year, nitrogen fertilizer was applied at a rate of 90 kg/ha to the Old World bluestem pastures.

Introduced Old World bluestem pastures represented a more homogeneous grazing site in contrast to the tallgrass native range pastures. Each year, Old World bluestem pastures (8.80 ± 2.22 ha) were grazed at an average stocking density of 311 kg of steer BW/ha, resulting in 1.56 ± 0.13 steers/ha (165 steers). This stocking rate was a conservative estimate to ensure forage availability was not limiting during the grazing period based on previous research at the Crosstimbers-Bluestem Stocker Range (Ackerman et al., 2001). Native pastures (32 ± 14 ha) were also stocked at an average rate of 0.38 ± 0.06 steers/ha for yr 1 (35 steers) and 0.45 ± 0.07 steers/ha for yr 2 (42 steers). Multiple sources of water were present, including free-flowing streams, ponds, and improved water sources, so that livestock had ad libitum access to water.

Three areas, within each pasture, that represented areas grazed by cattle were selected for sampling. Then, hand-plucked forage samples (Edelfsen et al., 1960) were collected in triplicate every other week throughout the supplementation phase of the study to determine forage quality (Table 1). Dry matter (oven drying at 55°C) was determined immediately following collection, and after drying, samples were ground through a Wiley Mill grinder (Thomas Scientific, Philadelphia, PA) using a 2-mm screen and stored for future proximate analysis.

**Animals**

All experimental protocols were approved by the Oklahoma State University Animal Care and Use Committee. In both years steers arrived in late spring. In yr 1, crossbred stocker steers (n = 200) consisting of primarily *Bos indicus* breeds arrived from Arizona, and in yr 2, crossbred stocker steers (n = 207), consisting of primarily British breeds with modest *Bos indicus* influence, arrived from Hawaii, via California, on 2 separate shipment dates. Upon arrival, cattle were dewormed with ivermectin according to label directions (5 mg of ivermectin/mL; Ivermax, American Livestock Supply Inc., Madison, WI), individually weighed, and identified with a treatment tag. Steers were provided a brief acclimation period at which time therapeutic treatments were administered whenever necessary for morbidity. In yr 2, because of a late arrival, load 2 was metaphylactically treated with tilmicosin phosphate (7 mL/steer; Micotil, Elanco Animal Health, Greenfield, IN).

Each year, 196 steers were used to evaluate performance while the extra steers were equally dispersed across tallgrass native range pastures and included in stocking rate calculations. On d 0, steers were removed from access to feed and water overnight (14 h), and on d 1 (May 29, 2008, and June 11, 2009) steers were weighed, palpated for implant presence, tagged by treatment, and implanted according to treatment.

Steers were stratified by arrival BW (216 ± 24 kg and 208 ± 23 kg for 2008 and 2009, respectively) and randomly allotted to 1 of 3 implant treatments. Implant treatments were 1) no implant (control); 2) Ralgro (RG; 36 mg of zeranol); and 3) Component TE-G, with Tylan (TEG; 40 mg of trenbolone acetate, 8 mg of estradiol USP, 29 mg of tylosin tartrate). Steers were assigned to treatments so that initial BW was uniform across all 3 implant treatments, and then steers within each implant treatment were randomly assigned to groups of 3. These groups of 3 were then randomly assigned to 1 of 15 pastures so that each implant treatment was equally represented across all pastures. All implants were administered on d 1 (same technician each year) in the middle third of the ear using the standard implanting device for the respective product. Prior to implantation, the ear and the implant-gun needle were disinfected, and after implantation, each ear was palpated to verify proper implant placement. Implant sites were evaluated via palpation of the ears at ~d 95 and d 126 and scored as follows: 1 = implant present, normal; 2 = implant present, abnormal; 3 = no implant present, normal; 4 = no implant present, abnormal.

Beginning in late July, within pasture type, pastures were randomly assigned to 1 of 3 supplement treatments and fed for 70 and 84 d for yr 1 and 2, respectively. Supplement treatments were (Table 2) 1) no supplement (control), 2) cottonseed meal–based supplement (CSM; 33% CP), and 3) dried distillers grains with solubles–based supplement (DDGS; 33% CP). Supplements were formulated to provide 125 mg/d per steer.
Supplements were group fed 3 times/wk and delivered as 0.48-cm pellets in bunks at a rate of 0.95 kg/steer (DM basis). Cattle were maintained in treatment groups for a grazing period of 126 d, and individual shrunk BW were obtained at the beginning of the supplementation period (~d 49), the mid-point (~d 95), and the conclusion of the experiment (d 126). Cattle were observed regularly throughout the study for morbidity.

### Laboratory Analysis

Forage and supplement samples were analyzed for laboratory DM (oven drying at 105°C), NDF and ADF (Ankom Tech Corp., Fairport, NY), ash (combusted 6 h in a muffle furnace at 500°C), CP (% N × 6.25; Truspec-CN LECO Corporation, St. Joseph, MI), and RDP (Krishnamoorthy et al., 1983). Supplement samples

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**Table 1. Composition of Old World bluestem (OWB) and tallgrass native range (NR) forages during summer supplementation from late July until early October during 2008 and 2009**

<table>
<thead>
<tr>
<th>Chemical component, % DM</th>
<th>Wk 2</th>
<th>Wk 4</th>
<th>Wk 6</th>
<th>Wk 8</th>
<th>Wk 10</th>
<th>Wk 12</th>
<th>P-value</th>
<th>Ptype</th>
<th>Wk</th>
<th>Ptype × Wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>OWB</td>
<td>42.6&lt;sup&gt;a,A&lt;/sup&gt;</td>
<td>38.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>41.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>48.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>46.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.02</td>
<td>0.01</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>NR</td>
<td>48.4&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>43.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>43.0&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>47.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>47.8&lt;sup&gt;bc&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OM</td>
<td>OWB</td>
<td>94.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>94.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>94.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>94.3&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>94.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>93.7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
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<td>NR</td>
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<td>94.6&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>94.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>94.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>95.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>94.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RDP</td>
<td>OWB</td>
<td>55.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>57.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>58.3</td>
<td>57.8</td>
<td>56.3</td>
<td>51.8</td>
<td>0.01</td>
<td>0.13</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>NR</td>
<td>41.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>45.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>51.2</td>
<td>54.5</td>
<td>53.0</td>
<td>47.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>OWB</td>
<td>8.2&lt;sup&gt;a,b,A&lt;/sup&gt;</td>
<td>10.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.7&lt;sup&gt;bc,A&lt;/sup&gt;</td>
<td>9.2&lt;sup&gt;bc,A&lt;/sup&gt;</td>
<td>7.7&lt;sup&gt;bc,A&lt;/sup&gt;</td>
<td>6.8&lt;sup&gt;a,A&lt;/sup&gt;</td>
<td>0.01</td>
<td>0.01</td>
<td>0.70</td>
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<tr>
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<td>NR</td>
<td>5.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDF</td>
<td>OWB</td>
<td>73.2&lt;sup&gt;a,A&lt;/sup&gt;</td>
<td>73.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>74.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>74.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>75.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>77.7&lt;sup&gt;a,A&lt;/sup&gt;</td>
<td>0.32</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>NR</td>
<td>71.5&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>72.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>74.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>75.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>76.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>75.2&lt;sup&gt;b,c,B&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADF</td>
<td>OWB</td>
<td>38.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>38.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>44.7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.03</td>
<td>0.01</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>NR</td>
<td>39.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>39.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>42.6&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>42.3&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>43.9&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>46.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a–d</sup>Means within the same row with the same letter are not statistically different at a 0.05 level of significance.

<sup>A,B</sup>Means within a column lacking a common superscript differ (P < 0.05).

<sup>1</sup>Probability of a greater F-statistic.

<sup>2</sup>Ptype = forage type of pastures (OWB or NR).

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**Table 2. Ingredients and chemical composition of cottonseed meal (CSM) and dried distillers grains with solubles (DDGS) supplements**

<table>
<thead>
<tr>
<th>Item</th>
<th>CSM</th>
<th>DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredients, % DM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cottonseed meal (44% CP)</td>
<td>55.70</td>
<td>31.49</td>
</tr>
<tr>
<td>Dried distillers grains with solubles</td>
<td>—</td>
<td>61.11</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>37.74</td>
<td>—</td>
</tr>
<tr>
<td>Cane molasses (pellet binder)</td>
<td>4.18</td>
<td>4.23</td>
</tr>
<tr>
<td>Limestone</td>
<td>2.22</td>
<td>1.86</td>
</tr>
<tr>
<td>Dical</td>
<td>—</td>
<td>1.15</td>
</tr>
<tr>
<td>Rumensin 80</td>
<td>0.16</td>
<td>0.16</td>
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</table>

<table>
<thead>
<tr>
<th>Chemical composition, % DM</th>
<th>2008</th>
<th>2009</th>
<th>2008</th>
<th>2009</th>
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</thead>
<tbody>
<tr>
<td>CP</td>
<td>31.80</td>
<td>33.90</td>
<td>34.30</td>
<td>34.60</td>
</tr>
<tr>
<td>RDP&lt;sup&gt;1&lt;/sup&gt;</td>
<td>75.04</td>
<td>76.51</td>
<td>50.64</td>
<td>52.89</td>
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<tr>
<td>Fat</td>
<td>3.20</td>
<td>3.90</td>
<td>9.90</td>
<td>10.00</td>
</tr>
<tr>
<td>TDN&lt;sup&gt;2&lt;/sup&gt;</td>
<td>69.40</td>
<td>69.00</td>
<td>87.00</td>
<td>85.60</td>
</tr>
<tr>
<td>Ca</td>
<td>1.08</td>
<td>1.44</td>
<td>0.94</td>
<td>1.04</td>
</tr>
<tr>
<td>P</td>
<td>1.04</td>
<td>1.16</td>
<td>1.12</td>
<td>1.25</td>
</tr>
<tr>
<td>S</td>
<td>0.34</td>
<td>0.45</td>
<td>0.62</td>
<td>0.76</td>
</tr>
</tbody>
</table>

<sup>1</sup>Determined using *Streptomyces griseus* procedure (Krishnamoorthy et al., 1983).

<sup>2</sup>Calculated using a multiple-component model including CP, lignin, ash, ether extract, ADIN, neutral detergent insoluble nitrogen, NDF, and in vitro NDF digestibility (Weiss et al., 1992).
were also sent to an independent laboratory (Dairy One, Ithaca, NY) and subjected to analysis of neutral detergent insoluble nitrogen, ADIN, ether extract, and lignin. Additionally, IVDMD was determined according to procedures outlined by Ankom Tech using the DAISYII incubator (Ankom Tech Corp.). These data were used to calculate TDN according to Weiss et al. (1992).

**Statistical Analysis**

Effects of type of implant and protein source on growth performance of steers were analyzed as a split-plot design using the PROC MIXED procedure of SAS (SAS Institute Inc., Cary, NC) with α = 0.05. Whole-plot was supplement treatment (pasture = experimental unit) and subplot was implant treatment (steer = experimental unit). Random variables included source, pasture, and source × pasture type × supplement within pasture. Source of cattle was used to account for effects of year and multiple shipment dates in yr 2. Pasture type was used to account for effects of forage type. Orthogonal contrasts were used to compare effects of implanting versus not implanting and to separate implant types. Similar methodology was used for supplementation effects. Effects of implant on ear score were analyzed using PROC FREQ procedures in SAS and Chi Square calculations to separate mean percent differences. The frequency tables included implant by ear score at d ~95 and d 126.

**RESULTS AND DISCUSSION**

There was no treatment × source interaction for initial BW ($P = 0.97$). The implant × supplement interaction for final BW or ADG during supplementation was not significant ($P = 0.50$ and 0.62, respectively). The failure to detect an interaction in this study validates the independence of implant and supplement treatments, and it can be concluded that full benefit from the implant and supplement program can be achieved if both are used simultaneously. There was also no protein source × forage type interaction for final BW and ADG during supplementation ($P = 0.36$ and 0.89, respectively). Therefore main effect means are presented (Tables 3 and 4).

**Supplementation**

Supplementation increased BW and ADG by 12 and 0.16 kg, respectively ($P < 0.05$). It should be noted that the independent responses to source of protein versus ionophore supplementation cannot be separated in this study because the protein source and ionophore supplement were fed in combination. Nevertheless, the observed increase in BW gain was somewhat lower than expected when compared with previous work.

**Table 3. Effects of protein source on performance of steers grazing summer warm-season grass pastures during 2008 and 2009**

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NR$^5$</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>OWB$^6$</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Steers, No.</td>
<td>131</td>
<td>130</td>
<td>131</td>
</tr>
<tr>
<td>BW, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 0</td>
<td>210</td>
<td>212</td>
<td>211</td>
</tr>
<tr>
<td>Initial</td>
<td>252</td>
<td>252</td>
<td>254</td>
</tr>
<tr>
<td>Final</td>
<td>317</td>
<td>325</td>
<td>331</td>
</tr>
<tr>
<td>BW gain, kg</td>
<td>64</td>
<td>74</td>
<td>78</td>
</tr>
<tr>
<td>ADG, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 0 to d ~49$^7$</td>
<td>0.90</td>
<td>0.87</td>
<td>0.92</td>
</tr>
<tr>
<td>d ~49 to ~95</td>
<td>0.95</td>
<td>1.10</td>
<td>1.14</td>
</tr>
<tr>
<td>d ~95 to 126</td>
<td>0.61</td>
<td>0.72</td>
<td>0.73</td>
</tr>
<tr>
<td>Overall</td>
<td>0.81</td>
<td>0.93</td>
<td>0.98</td>
</tr>
</tbody>
</table>

$^1$Treatments include 1) no supplement (NSP; control), 2) cottonseed meal–based supplement (CSM; 33% CP), and 3) dried distillers grains with solubles–based supplement (DDGS; 33% CP).

$^2$Probability of a greater $F$-statistic.

$^3$No supplement vs. supplementation.

$^4$Cottonseed meal vs. dried distillers grains with solubles.

$^5$Tallgrass native range.

$^6$Old World bluestem.

$^7$Steers were not being supplemented during this time period.
example, in 9 experiments under similar grazing conditions, steers were provided 0.41 to 0.54 kg/d per steer of a 38 to 41% protein supplement. In these studies, response to protein supplementation (with no ionophore) averaged 0.17 ± 0.04 kg/d per steer with a range of 0.12 to 0.23 kg/d per steer (Lalman, 2008). Including an ionophore in late-summer grazing supplements has resulted in an additional improvement in ADG of 0.07 to 0.13 kg/d per steer (Armbruster et al., 1980; McCollum et al., 1988). Therefore, based on previous work, total expected improvement in rate of BW gain due to supplementing protein and an ionophore could range from 0.19 to 0.36 kg/d per steer.

The cause for relatively low response to supplementation in the current experiment is unclear. Experimental diets were lower in protein than those used in the data summarized by Lalman (2008), providing the minimum amount of supplemental protein (0.14 kg/d per steer) for an expected increase in growth performance. Therefore, providing additional supplemental protein may have resulted in greater BW gains and reduced supplement conversions.

When comparing sources of protein, rate of BW gain was improved by DDGS (0.05 kg; $P < 0.05$) compared with CSM. This resulted in a supplement conversion of 2.67 versus 3.78 kg of supplement per kilogram of additional ADG for DDGS and CSM, respectively. A significant proportion of the energy supplied by DDGS is in the form of fat (9.95%), and MacDonald et al. (2006) demonstrated that the inclusion of oil at the same ether extract concentration as DDGS did not increase ADG similarly. The supplement containing DDGS may alleviate a deficiency of metabolizable protein (MacDonald et al., 2006). It has been suggested by McCollum and Horn (1990) that providing escape protein to cattle consuming low-quality forages may reduce the amount of protein needed. Hailey et al. (1993) reported an improvement in ADG when yearling steers grazing warm-season grasses were supplemented with 0.2 kg of RUP. Winterholler et al. (2009b) demonstrated that CP of CSM is 73.5% ruminally degradable in cattle consuming low-quality roughage, resulting in minimal escape protein. Conversely, tabular values from NRC (2000) show that DDGS is only 45.1% ruminally degradable. When urea was added to DDGS in supplements deficient in RDP, there was no additional improvement in performance of heifers consuming grass hay (Stalker et al., 2004). However, Hailey et al. (1993) did show that a supplement combination of RDP and RUP improved ADG as compared with RUP alone, and there was a numerical improvement (0.05 kg) when compared with providing only RDP. The complexity of the interactions of RDP and RUP and their effects on animal performance are beyond the scope of this study, but these data may provide evidence that combining a protein source high in RUP with a plant protein source high in RDP can improve ADG in summer stocker steers.

Another potential reason for the difference in response due to supplement source may be the inadequacy of digestible energy from CSM (69.2% TDN) to support equivalent microbial growth and protein utilization as DDGS (86.3% TDN). However, energy provided by forage may actually be less for DDGS-supplemented steers than steers provided CSM because of possible differences in forage DMI.

### Table 4. Effects of the type of single dose, moderate term implant on performance of steers grazing summer warm-season grass pastures during 2008 and 2009

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment¹</th>
<th>P-value²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NI</td>
<td>RG</td>
</tr>
<tr>
<td>Steers, No.</td>
<td>130</td>
<td>132</td>
</tr>
<tr>
<td>BW, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>211</td>
<td>211</td>
</tr>
<tr>
<td>Final</td>
<td>319</td>
<td>325</td>
</tr>
<tr>
<td>BW gain, kg</td>
<td>108</td>
<td>113</td>
</tr>
<tr>
<td>ADG, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 0 to d ~49</td>
<td>0.87</td>
<td>0.90</td>
</tr>
<tr>
<td>d ~49 to ~95</td>
<td>0.99</td>
<td>1.08</td>
</tr>
<tr>
<td>d ~95 to 126</td>
<td>0.67</td>
<td>0.66</td>
</tr>
<tr>
<td>Overall</td>
<td>0.86</td>
<td>0.90</td>
</tr>
</tbody>
</table>

¹Treatments include 1) no implant (NI; control), 2) Ralgro (RG; 36 mg of zeranol; Schering-Plough Animal Health Corp., Union, NJ), and 3) Component TE-G, with Tylan (TEG; 40 mg of trenbolone acetate, 8 mg of estradiol USP, 29 mg of tylosin tartrate; Ivy Animal Health, Overland Park, KS).

²Probability of a greater $F$-statistic.

³No implant vs. Implant.

⁴Ralgro vs. Component TE-G.
It has been shown that supplementing DDGS to weaned calves consuming low-quality forage has a negative influence on hay DMI of 0.32 kg for every 1 kg of DDGS supplemented (Winterholler et al., 2009a). In the current study, DDGS was supplied at 0.64 kg 3 times/wk resulting in an estimated potential decrease in forage DMI of 0.20 kg each time supplemented. Moreover, Morris et al. (2006) showed that when supplementing DDGS to summer stocker steers, forage DMI decreased linearly with increasing levels of DDGS, but ADG also increased linearly, suggesting that the energy provided by DDGS can overcome the potential loss of energy intake from a small decrease in forage intake.

### Table 5. Ear palpation score ~95 d and 126 d postimplantation with Ralgro (RG) or Component TE-G (TEG)

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment</th>
<th>P-value²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NI</td>
<td>RG</td>
</tr>
<tr>
<td>No.</td>
<td>130</td>
<td>132</td>
</tr>
<tr>
<td>Ear score³ d ~95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormality¹ present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent present</td>
<td>0.0a</td>
<td>5.3b</td>
</tr>
<tr>
<td>Number/total</td>
<td>0/130</td>
<td>7/132</td>
</tr>
<tr>
<td>Palpable implant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent present</td>
<td>0.0a</td>
<td>3.8b</td>
</tr>
<tr>
<td>Number/total</td>
<td>0/130</td>
<td>5/132</td>
</tr>
<tr>
<td>d 126</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormality present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent present</td>
<td>0.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Number/total</td>
<td>0/130</td>
<td>5/132</td>
</tr>
<tr>
<td>Palpable implant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent present</td>
<td>0.0a</td>
<td>0.8b</td>
</tr>
<tr>
<td>Number/total</td>
<td>0/130</td>
<td>1/132</td>
</tr>
</tbody>
</table>

*Means within the same row with the same letter are not statistically different at a 0.05 level of significance.

¹Treatments include 1) no implant (NI; control), 2) Ralgro (RG; 36 mg of zeranol; Schering-Plough Animal Health Corp., Union, NJ), and 3) Component TE-G, with Tylan (TEG; 40 mg of trenbolone acetate, 8 mg of estradiol USP, 29 mg of tylosin tartrate; Ivy Animal Health, Overland Park, KS).

²Probability of chi-squared.

³Scores: 1 = implant present, normal; 2 = implant present, abnormal; 3 = no implant present, normal; 4 = no implant present, abnormal.

⁴Abnormality = any blemish found on the ear at the location of implant administration.

It has been shown that supplementing DDGS to weaned calves consuming low-quality forage has a negative influence on hay DMI of 0.32 kg for every 1 kg of DDGS supplemented (Winterholler et al., 2009a). In the current study, DDGS was supplied at 0.64 kg 3 times/wk resulting in an estimated potential decrease in forage DMI of 0.20 kg each time supplemented. Moreover, Morris et al. (2006) showed that when supplementing DDGS to summer stocker steers, forage DMI decreased linearly with increasing levels of DDGS, but ADG also increased linearly, suggesting that the energy provided by DDGS can overcome the potential loss of energy intake from a small decrease in forage intake.

### Implantation

Final BW was increased in steers implanted with TEG as compared with control steers ($P < 0.05$). Change in BW was increased due to implantation by 5 and 11 kg for RG and TEG, respectively ($P < 0.05$). This gain in BW from RG is less than the average improvement of 12 kg reported by Kuhl (1997). However, there are no published data reporting an average increase in BW gain from TEG during the stocker phase in growing steers. Implantation increased ADG by $7.0\%$ ($0.86 \text{ vs. } 0.92 \text{ kg/d}; P < 0.05$) during the entire grazing period (126 d). This improvement is slightly lower than the range suggested by Reuter et al. (2008) of 0.08 to 0.12 kg of ADG. Differences in type of cattle and year of forage production may cause these differences. Furthermore, type of implant influenced ADG ($P < 0.05$). When compared with RG, TEG positively influenced rate of BW gain by 0.04 kg for the entire grazing period. But more importantly, ADG was increased by 0.08 kg during the final ~31 d, whereas RG was similar to control (0.68 and 0.67 kg/d, respectively). This may be due to a slower payout rate of TEG as suggested by ear palpation results presented in Table 5. There was an increased presence of implants in cattle administered TEG at ~95 and 126 d ($P < 0.05$).

**Figure 1.** Economic evaluation of implanting and supplementing summer stocker steers. The horizontal bar represents average value of gain from 1999 to 2009 during the summer grazing season (CattleFax, 2010). CSM = cottonseed meal-based supplement; DDGS = dried distillers grains-based supplement. Ralgo = Ralgo implant (Schering-Plough Animal Health Corp., Union, NJ); TEG = Component TE-G implant (Ivy Animal Health, Overland Park, KS).
from 6 to 10%. Botts (2002) reported that implant
ed steers (P > 0.05). Anderson and 
that is not different from nonimplant-
a very low detection rate of defects 
RG and TEG, respectively. However, 
implants with a lactose matrix (car-
whereas implants with a cholesterol 
carrier have been deemed long acting 
(Istasse et al., 1988).
Implanting site defects occurred at 
a rate of 5.3 and 10% at day ~95 for 
RG and TEG, respectively. However, the 
final palpation data demonstrate a 
very low detection rate of defects 
that is not different from nonimplant-
ed steers (P > 0.05). Anderson and 
Botts (2002) reported that implant 
site defects in feedlot cattle ranged 
from 6 to 10%.

**Economics**

To evaluate the potential economic return from the use of these manage-
ment strategies, a simple analysis was 
conducted using average feeder cattle 
prices from 1999 to 2009 (CattleFax, 
2010) and average commodity prices 
from 2004 to 2009 (USDA, 2010). The 
value of gain was calculated using the 
average initial price for a 204-kg 
steer on June 1 and the average final 
price for a 318-kg steer on October 
15 (i.e., final value – initial value/ 
BW change). The calculated value 
of gain during this period was $1.36 
per kilogram of BW gain. Feed costs 
were calculated using the price per 
kilogram of CSM, DDGS, and wheat 
middlings in each supplement. Figure 
1 displays the cost of gain for protein 
source and implant types relative to 
this cost of gain. It is evident that 
supplementation and implantation 
are cost-effective means of improving 
production and profitability.

**IMPLICATIONS**

Using DDGS as the primary ingredi-
ent of a monensin-containing pro-
tein supplement in combination with 
cottonseed meal can increase growth 
and improve supplement conversion of 
steers grazing summer warm-season 
grasses. In addition, Ralgro and Com-
ponent TE-G implants cost $1.12 and 
$1.34, respectively (Valley Vet Sup-
ply), and return 5 and 11 kg to calves 
grazing summer warm-season grasses 
for 126 d. This results in a cost of 
gain of $0.22 and $0.12 per kilogram 
of BW gain for Ralgro and Compo-
ponent TE-G, respectively. These low 
costs for improvements in rate of BW 
gain are complimentary to those BW 
gains captured by providing small 
amounts of a monensin-containing 
protein supplement. The full benefit 
of using supplement and implant 
programs can be captured if used si-
multaneously with steers grazing Old 
World bluestem or native range in a 
season-long grazing system.

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