ABSTRACT

Field peas were evaluated in beef growing and finishing diets in a 2-yr experiment. A total of 114 steers (initial BW = 348 kg, SD = 22 kg) in yr 1 and 114 heifers (initial BW = 249 kg, SD = 11 kg) in yr 2 were used in a 3 × 2 factorial. The first factor was grazing supplementation (0.5% BW, DM basis) with the following treatments: (1) field pea (FP); (2) blend of 70.8% corn, 24% corn condensed distillers solubles, and 5.2% urea (CB); and (3) no supplement (CON). The second factor was presence or absence of 20% FP in finishing diets. Growing phase ADG was greatest for CB, followed by FP and CON (0.99, 0.87, and 0.69 ± 0.08 kg for CB, FP, and CON, respectively; P < 0.01). There were no interactions between growing and finishing treatment, and presence of FP in the finishing diet did not affect finishing performance or carcass characteristics (P ≥ 0.20). However, grazing supplementation influenced finishing performance; CON had the greatest finishing ADG, whereas CB and FP did not differ (1.93, 1.79, and 1.79 ± 0.06 kg for CON, CB, and FP, respectively; P < 0.01). The CON treatment was also most efficient, followed by CB and FP, which were not different (0.145, 0.135, 0.138 ± 0.014, for CON, CB, and FP, respectively; P = 0.01). Field peas may be fed to growing and finishing cattle if appropriately priced. However, reduced ADG during the growing phase may result in compensatory gain in the finishing phase.

Key words: cattle, field peas, finishing, grazing

INTRODUCTION

On a national scale, the number of hectares planted to field peas in the United States increased from 146,496 in 2011 to 513,141 million in 2016 (NASS, 2016). Processing capacity for field pea grain has not kept pace with production. Although a large part of this production is used in the human consumption and pet food market, there has also been an increase in the availability of commodity peas for the livestock feed market. The majority of field peas are designated for the human consumption market (McKay et al., 2003). However, those market outlets are limited in the amount of product that they can purchase due to limitations in processing, as well as the maintenance of quality standards. Therefore, feeding field peas to livestock, specifically cattle, began because of a surplus of low quality field peas with no outlet (Fendrick et al., 2006). Petit et al. (1997) suggested that field peas could be used as a protein and energy source in livestock diets. Previous research has shown that field peas are capable of providing similar or improved performance compared with other cereal grains such as corn, wheat, millet, barley, and so on at moderate inclusion rates (Reed et al., 2004; Jenkins et. al, 2011).

Peas provide a viable rotation in wheat production because they fix nitrogen in the soil and naturally break up pest cycles (Haynes et al., 1993; Walley et al., 2007). Determining the best use of field peas for the livestock sector is important for both the cattle producer and field pea farmer. This study was designed to determine the efficacy of field peas as a supplement to cattle grazing pasture, in comparison with cattle consuming dry-rolled corn when supplemental RDP was added to the equivalent of that contained in field peas. Following grazing, a second phase either included or excluded field peas from the finishing diets. Therefore, the objective of this study was to determine the effects of feeding field peas during growing and finishing phases on the animal and carcass characteristics.

MATERIALS AND METHODS

All animal care and management procedures were approved by the University of Nebraska–Lincoln Institutional Animal Care and Use Committee.

A total of 114 crossbred steers (initial BW = 348 kg, SD = 22 kg) in yr 1 and 114 crossbred heifers (initial BW = 249 kg, SD = 11 kg) in yr 2 were used in a 3 × 2 factorial arrangement of treatments. Cattle were limit fed at 2% BW for 5 d and then weights were collected on 2 consecutive days to minimize the effect of gut fill (Watson et al., 2013). Cattle were blocked by BW, stratified by BW within blocks, and randomly assigned to 3 weight blocks. Then cattle were randomly assigned to initial pasture, which had been assigned to treatment. Cattle were also implanted with 40 mg of trenbolone acetate and 8 mg of estradiol.
(REVALOR-G, Merck Animal Health, Kenilworth, NJ); given a 5-way respiratory vaccination against infectious bovine rhinotracheitis, bovine viral diarrhea types I and II, parainfluenza-3, and bovine respiratory syncytial virus (yr 1: Express FP 5, Boehringer Ingelheim, St. Joseph, MO; yr 2: Titanium 5, Elanco Animal Health, Greenville, IN); and poured with Eprinomectin endectocide (IVOMEC, Merial Limited, Duluth, GA). The first factor of the trial was the 3 supplementation treatments applied during a summer grazing season. Supplementation occurred at a rate of 0.5% BW (DM Basis) prorated for 6 d in a 7-d period and was fed at approximately 0800 h.

The 3 treatments consisted of (1) whole, unprocessed field peas (90.4% DM, 26.8% CP, 32.2% starch; FP); (2) a mixture of dry-rolled corn (84.2% DM, 8.9% CP, 72.9% starch) (70.8%), condensed distillers solubles (24%), and urea (5.2%) balanced to provide similar RDP to the field peas (corn blend, CB); and (3) control group receiving no supplement (CON). There were 4 replications per treatment per year, resulting in a total of 8 replications per treatment across 2 yr. Each replicate (experimental unit) consisted of 8 or 10 head. Cattle grazed 12 crested wheatgrass pastures grouped in their experimental units at the High Plains Agriculture Laboratory near Sidney, Nebraska. Cattle were allowed 4.25 ha per animal for a 4-mo grazing season. The cattle rotated through pastures every 2 wk so that each experimental unit grazed a different pasture every 2 wk to minimize pasture effects on treatment. Cattle had ad libitum access to trace mineralized salt blocks. The grazing period was 117 d in yr 1 and 142 d in yr 2.

Pasture samples were collected at the beginning of the grazing period (June) and at the end of the grazing period (August) in 2015 (Table 1). Three pastures were selected at random to be the representative samples for the 12 pastures. Six random collection sites within each pasture were used to clip total area samples measuring 0.61 m by 0.61 m in area. Samples were then dried in a forced-air oven at 60°C (model LBB2–21–1; Despatch Industries, Minneapolis, MN) for 48 h (AOAC Method 935.29, AOAC International, 2016) and ground through a 1-mm screen using a Wiley mill (number 4; Thomas Scientific, Swedesboro, NJ). Processed samples were then analyzed for OM, IVDM, CP, NDF, and ADF. Ash was determined by placing samples in a muffle furnace for 6 h at 600°C (AOAC, Method 942.05, AOAC International, 2016). In vitro OM and DM digestibility were determined with the use of the in vitro method described by Tilley and Terry (1963) modified by adding 1 g/L of urea to the McDougall’s buffer (Weiss, 1994). Crude protein was determined through the use of a combustion chamber (TruSpec N Determinator; Leco Corporation, St. Joseph, MI; AOAC Method 990.03, AOAC International, 2016). Neutral detergent fiber and ADF analysis was conducted using the procedure described by Van Soest et al. (1991) without the addition of amylase or sodium sulfite.

The second factor in the experiment was finishing with or without field peas in the dry-rolled corn (DRC)–based finishing diet. The finishing period was conducted at the Panhandle Research and Extension Center feedlot near Scottsbluff, Nebraska. At the conclusion of the grazing period, cattle were shipped to the feedlot where they remained in their respective grazing groups in 1 of 12 pens. Upon arrival cattle were limit fed for 5 d a diet consisting of 35% wheat straw, 35% corn silage, 20% wet distillers grains, and 10% distillers condensed solubles (DM basis). On the fifth and sixth days cattle were weighed, implanted with 200 mg of trenbolone acetate and 40 mg of estradiol in yr 1 and 200 mg of trenbolone acetate and 20 mg of estradiol in yr 2 (yr 1: REVALOR-XS, yr 2: REVALOR-200, Merck Animal Health), given a 7-way bacterial-toxoid vaccine (Vision 7 Sommus, Merck Animal Health) and a 5-way respiratory vaccine (yr 1: Express FP 5, Boehringer Ingelheim; yr 2: Titanium 5, Elanco Animal Health), and poured with Eprinomectin endectocide (IVOMEC, Merial Limited).

The finishing diets were a DRC-based finishing diet with or without 20% whole, unprocessed FP (DM basis; Table 2). Monensin was included at 300 mg/head daily, and tylosin was included at 90 mg/head daily (Rumensin and Tylan, Elanco Animal Health). Cattle were fed once daily in the morning, and diets were provided ad libitum. Feed bunks were assessed at approximately 0600 h and managed so that trace (<0.2 kg) amounts of feed were left in the bunk each morning at time of feeding. Feed was delivered with a truck-mounted mixer and delivery unit (Roto-Mix model 274, Roto-Mix, Dodge City, KS; scale readability ±0.91 kg) each morning at 0800 h. Cattle were adapted to a finishing diet over a 21-d period using 4 diets with corn replacing alfalfa hay. Diets containing field peas in the finisher contained field peas in the adaptation diets as well.

Days on feed were 119 and 131 d for yr 1 and yr 2, respectively. Cattle were slaughtered and carcass data were collected at Tyson Foods in Lexington, Nebraska.

### Table 1. Nutrient analysis of clipped samples from crested wheatgrass pastures

<table>
<thead>
<tr>
<th>Nutrient analysis, % DM</th>
<th>June 2015</th>
<th>August 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVDMD</td>
<td>49.0</td>
<td>40.3</td>
</tr>
<tr>
<td>NDF</td>
<td>69.5</td>
<td>68.8</td>
</tr>
<tr>
<td>ADF</td>
<td>47.6</td>
<td>48.0</td>
</tr>
<tr>
<td>CP</td>
<td>8.7</td>
<td>6.4</td>
</tr>
</tbody>
</table>

1Established, predominately crested wheatgrass pastures near Sidney, Nebraska, at the University of Nebraska High Plains Agricultural Laboratory in 2015.
Economic Analysis

An economic analysis was conducted to estimate the value of field peas as a feedstuff compared with corn on an energy basis. To calculate cost of the animal, data accumulated by the Livestock Marketing Information Center (Lakewood, CO) was used to develop 10-yr averages (2004–2014). In yr 1, medium to large frame #1 steer prices were used for the month in which the steer was purchased or sold, and in yr 2, medium to large frame #1 heifers were used. Initial cost of the animal, predicted cost of the animal after the grazing phase, and finally the slaughter cattle price were all gathered from the reports that summarized prices from all Nebraska auction markets. Prices were used from the weight ranges that corresponded with each transition in the trial. For example, initial cost of the animal price for yr 1 used the price per 45.5 kg for 341- to 364-kg steers, and 409- to 432-kg steers for end of grazing/initial feedlot price. For yr 2, prices were used for heifers instead of steers due to animal differences between the 2 yr. For the initial cost of the animal, weekly averages from the month of May were used to determine accurate seasonal average. The month of September was used for the end of the grazing period. Slaughter prices were taken from the month of January for yr 1 and February for yr 2.

A grazing rental value for pasture was determined by using the 10-yr average pasture rental rate for 250- to 273-kg calves in the northwest region of Nebraska (Jansen and Wilson, 2015). This calculated value was $10.27/0.4 ha.

Supplement cost for those cattle receiving FP was calculated based on the human consumption market ($4.50/0.035 m³; 27.2 kg in 0.035 m³) because there is no established price for livestock feed grade peas. To determine the cost of the CB, the 10-yr average corn price from 2004 to 2014 was used based on the USDA Agriculture Marketing Service (USDA, 2016) of $4.40/0.035 m³. Corn condensed distillers solubles were evaluated at the same price as corn. The price of urea was also a 10-yr average of prices reported by Index Mundi (2017) for the month of April from 2004 to 2014. Finishing diet cost was also formulated using the same corn and field pea prices, with corn silage price being set at 9 times the value of corn. A 10-yr average was also used to price wet distillers grains (USDA, 2016). Mineral supplement cost was collected from the University of Nebraska–Lincoln Feed Production facility.

Labor costs for both grazing and finishing were adapted from Warner et al. (2015). During grazing, the CON treatment was charged $0.10/head daily, FP was charged $0.20/head daily, and CB was charged $0.25/head daily, reflecting differences in labor requirements for delivering each supplement strategy. Equal yardage for all treatments was applied during the finishing phase at 0.45/ head daily. Cost of transporting the cattle from pasture to the feedlot was based on an area average of $4.00/loaded 1.6 km with a 114-km trip.

To determine interest cost on the live cattle, an annual rate of 4.5% was applied to the initial cost of the animal and then prorated to the number of months the cattle were owned [Interest Months = (Grazing Days + Days on Feed)/30]. Feed interest was calculated based using the same 4.5% annual rate for half the amount of time on feed applied to the total feed costs for the finishing period.

Statistical Analysis

Data were analyzed as a randomized complete block design using PROC MIXED procedure of SAS (SAS Institute Inc., Cary, NC). The treatments were analyzed as a 2 × 3 factorial arrangement. The grazing and finishing models included treatment as a fixed effect with year and block within year as random effects. The experimental unit for animal performance and economic analysis was pasture/pen.

RESULTS AND DISCUSSION

Pasture nutrient composition analysis (Table 1) is included as a reference for the quality of pastures used in this study. Although the quality seems low for the growing season, Pesta et al. (2012) reported similar CP and IVDMD on these same predominately crested wheatgrass pastures. Historically, this crested wheatgrass has grown rapidly in May, beginning to reach maturity by mid-June.

During the grazing phase ending BW and ADG (<0.01) were greatest for calves supplemented CB, followed by FP and CON (Table 3). The starch in corn might be expected to negatively affect forage digestion, which, in turn, would be expected to negatively affect ADG. However, Fieser and Vanzant (2004) reported no differences in forage digestion of similar quality forage when soyhulls or corn was supplemented at 0.67% BW. This suggests per-

<table>
<thead>
<tr>
<th>Table 2. Finishing diet composition (DM basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredient, %</td>
</tr>
<tr>
<td>Dry-rolled corn</td>
</tr>
<tr>
<td>Field peas</td>
</tr>
<tr>
<td>WDGS1</td>
</tr>
<tr>
<td>Corn silage</td>
</tr>
<tr>
<td>Mineral supplement2</td>
</tr>
<tr>
<td>CP</td>
</tr>
<tr>
<td>NDF</td>
</tr>
<tr>
<td>Crude fat</td>
</tr>
<tr>
<td>Ash</td>
</tr>
</tbody>
</table>

1WDGS = wet distillers grains with solubles.
2Supplement included monensin at a rate of 360 mg/ head per day and tylosin at 90 mg/head per day, 8% CP, 0.5% crude fat, 4.7% Ca, 0.06% P, 3.5% salt, 3.8% K, and 4,918 IU/kg of vitamin A.
haps the current supplement at 0.5% BW was not great enough to affect forage digestibility and therefore ADG. Chen et al. (2003) reported improved ADG in growing heifers over the control diet when field peas were fed as a supplement to a low quality forage diet. The heifers supplemented with field peas gained similarly to heifers supplemented with canola meal. In contrast to the present study, Anderson (1999) compared field peas to combinations of barley and canola meal as a growing calf protein supplement and found similar gain between the treatments.

In the finishing phase there were no interactions between growing and finishing treatments, nor was a significant effect of finishing treatment for animal performance and carcass characteristics observed ($P \geq 0.20$; Table 4). Gillespie-Lewis et al. (2016) found summer supplementation of pasture cattle to decrease feedlot finishing G:F but, as

| Table 3. Effect of corn and pea supplementation$^1$ on performance of growing calves |
|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|
| Item                             | CON     | CB      | FP      | SED$^2$ | Treatment |
| Initial BW, kg                   | 301     | 300     | 300     | 1.48    | 0.82     |
| Ending BW, kg                    | 382$^a$ | 416$^b$ | 402$^b$ | 4.19    | $<0.01$ |
| ADG, kg/d                        | 0.69$^c$| 0.99$^d$| 0.87$^b$| 0.08    | $<0.01$ |

$^a$–$^c$Within a row, means without a common superscript differ.

$^1$Treatments: cattle grazed 117 d (2014) or 142 d (2015) either without supplement (CON) or supplemented at 0.5% of BW with either dry-rolled corn (70.8%), solubles (24%), and urea (5.2%) (CB) or whole, unprocessed field peas (FP).

$^2$SED = SE of the difference.

Table 3.

| Table 4. Effect of field peas on performance in finishing diets$^1$ |
|-----------------------------|---------|-----------------------------|---------|---------|---------|---------|---------|---------|---------|
| Item                        | No field peas | Field peas | SED$^2$ | Growing | Finishing | Interaction | $P$-value |
| Initial BW, kg              | CON     | CB      | FP      | 393     | 400     | 394     | 393     | 405     | 394     | 6.2     | $<0.01$ | 0.59     | 0.35     |
| Final BW, kg                | 623     | 636     | 626     | 1.35    | 1.48    | 1.44    | 1.44    | 1.49    | 1.45    | 0.12    | 0.68     | 0.61     | 0.36     |
| ADG, kg/d                   | 13.4    | 13.3    | 13.0    | 35.8    | 34.9    | 35.0    | 34.1    | 35.3    | 34.8    | 0.82    | 0.93     | 0.26     | 0.20     |
| DMI, kg                     | 0.043   | 0.134   | 0.140   | 486     | 504     | 501     | 468     | 493     | 484     | 26.6    | 0.80     | 0.82     | 0.29     |
| G:F, kg/kg                  | 3.15    | 3.43    | 3.31    | 3.31    | 3.31    | 3.37    | 0.18    | 0.18    | 0.18    | 0.55    | 0.55     | 0.55     | 0.55     |

$^1$Finishing treatment: cattle with peas in the diet had 20% of the DM of the diet as peas (by displacing dry-rolled corn); the diet with no peas still included that 20% as dry-rolled corn. Growing treatment: cattle were grazed for 142 d either without supplement (CON) or supplemented at 0.5% of BW with either dry-rolled corn (70.8%), solubles (24%), and urea (5.2%) (CB) or whole, unprocessed field peas (FP), depending on assigned treatment.

$^2$SED = SE of the difference.

$^3$Initial BW main effects of growing treatment: CB > FP > CON ($P < 0.01$).

$^4$Final BW was calculated as HCW/0.63.

$^5$ADG and G:F main effect of growing treatment: both measures favored CON over CB and FP ($P < 0.01$); CB and FP were similar ($P \geq 0.57$).

$^6$Marbling: 400 = Slight$^{60}$, 500 = Small$^{50}$.

$^7$Calculated as YG = 2.50 + (6.35 × fat depth, cm) − (2.06 × LM area, cm$^2$) + (0.2 × KPH, %) + (0.0017 × HCW, kg) (USDA, 1997).
Greenwell et al. (2015) saw no effect on carcass characteristics. They reported no effect of summer supplementation on overall system profit. Lomas et al. (2009) reported no effect of summer supplementation on finishing performance or carcass characteristics but did report that the BW advantage gained on pasture was maintained through finishing.

Initial BW for the feedlot period was affected by growing treatment ($P < 0.01$) as a reflection of ending BW for the grazing period (Table 4). Feedlot ADG was also affected by growing treatment ($P < 0.01$). Cattle in the CON treatment had greater ADG ($P < 0.01$) than cattle supplemented CB and FP, which tended to differ ($P = 0.07$). Final BW and HCW tended ($P = 0.07$) to be affected by growing treatment in a similar manner to feedlot ADG. This compensatory gain response by cattle on a lower plane of nutrition when moved to improved nutrition has been previously reported (Drouillard et al., 1991; Hersom et al., 2003; Jenkins et al., 2009). Conversely, Elizalde et al. (1998) saw no effect of grazing supplement on subsequent feedlot performance when supplementing multiple levels of protein and energy to steers grazing tall fescue. Coffey et al. (1994) supplemented ground grain sorghum at 0.25 or 0.5% BW to steers grazing tall fescue and also did not see effects of grazing treatment on finishing performance. Watson et al. (2010) supplemented dried distillers grains on brome pastures during the summer and observed improved performance while grazing over nonsupplemented cattle, but they saw no difference in subsequent feedlot gain.

Cattle were most efficient in the finishing phase when they did not receive supplement on pasture. The CON had greater G:F ($P \leq 0.01$) than CB and FP. The differences in G:F are the result of consistent DMI across treatments ($P = 0.27$) and the differences in ADG previously discussed. Hersom et al. (2003) also reported increased G:F during the finishing phase for cattle gaining less during the grazing phase. The CON cattle compensated 54% compared with cattle supplemented CB and 90% compared with cattle supplemented FP during grazing. Therefore, even though the CON cattle compensated, there was a tendency ($P = 0.07$) for final BW to be greater for cattle receiving supplement during grazing.

No differences were observed for DMI during the finishing phase. The effect of including field peas on DMI in the finishing diet has been inconsistent. Pesta et al. (2012) included field peas at 0 or 20% DM and also reported no differences in DMI. No differences were reported when field peas replaced DRC and barley or DRC in finishing diets (Lardy et al., 2009; Jenkins et al., 2011). Loes et al. (2004) reported no differences when field peas were included in lamb finishing diets. Conversely, Fendrick et al. (2005) reported that DMI increased with increasing inclusion of field peas in the diet, with the peak being at 40% inclusion. Lardy et al. (2009) reported a decrease in DMI when field peas replaced combinations of DRC, high-moisture corn, and canola meal, as did Flatt and Stanton (2000) when field peas replaced whole corn. A decrease in DMI was also observed when field peas were used as a substitute in by-product–based, medium-concentrate diets (Soto-Navarro et al., 2004).

There was no significant effect of finishing treatment on animal performance or carcass characteristics during the finishing phase ($P \geq 0.25$). Similar to the current study, others have reported that inclusion of field peas in finishing diets has no effect on G:F (Fendrick et al., 2005; Carlin et al., 2006; Jenkins et al., 2011). Conversely, Flatt and Stanton (2000) reported including field peas at 20% replacement of corn increased G:F, with a decrease in DMI and a steady ADG.

Inclusion of FP in the finishing diet had no effect on carcass characteristics, which was also reported by Jenkins et al. (2011) and Pesta et al. (2012). The effects of FP on carcass characteristics have been inconsistent. Lardy et al. (2009) observed a quadratic increase in 12th-rib fat and a linear increase in marbling score as field pea levels in-

### Table 5. Economic analysis of grazing period

<table>
<thead>
<tr>
<th>Item</th>
<th>CON</th>
<th>CB</th>
<th>FP</th>
<th>SED^2</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial animal value, $/head</td>
<td>867.04</td>
<td>864.51</td>
<td>864.70</td>
<td>4.34</td>
<td>0.96</td>
</tr>
<tr>
<td>End of grazing animal value, $/head</td>
<td>1,057.27c</td>
<td>1,150.25a</td>
<td>1,113.36b</td>
<td>11.28</td>
<td>0.04</td>
</tr>
<tr>
<td>Costs, $/head</td>
<td>113.60c</td>
<td>206.42a</td>
<td>195.94b</td>
<td>0.81</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Cost of gain, $/kg</td>
<td>0.34a</td>
<td>0.39b</td>
<td>0.43c</td>
<td>0.02</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Net profit, $/head</td>
<td>74.87a</td>
<td>77.56b</td>
<td>50.97c</td>
<td>11.86</td>
<td>0.02</td>
</tr>
</tbody>
</table>

*Within a row, means without a common superscript differ.
*Treatments: cattle grazed 117 d (2014) or 142 d (2015) either without supplement (CON) or supplemented at 0.5% of BW with either dry-rolled corn (70.8%), solubles (24%), and urea (5.2%) (CB) or whole, unprocessed field peas (FP).
*SED = SE of the difference.
Field peas in beef cattle growing and finishing diets

Increased. In dry-rolled corn–based diets, Lardy et al. (2009) and Jenkins et al. (2011) reported no difference in YG; however, there was a tendency for an increase in YG in barley-based diets. Also, Fendrick et al. (2006) reported a linear decrease in LM with increased field pea levels reaching as high as 59%. Whereas Jenkins et al. (2011) reported no effects on marbling score with increasing field pea levels, Anderson (1999) observed increased marbling scores, followed by an expected increase in number of carcasses graded USDA Choice.

During the grazing period, the value of the animal, the costs during grazing, and net profit were affected by grazing treatment ($P < 0.04; Table 5). Those cattle supplemented CB on pasture had an average value of $1,150.25/head, which was greater than those supplemented with FP ($1,113.36/head), which was also greater than the CON ($1,057.27/head). This would be expected because it mirrors the results of ending BW for the grazing period. Costs ($/head) during the grazing period were also greatest for CB, and then FP, with CON having the cheapest costs ($206.42, $1,195.94, $113.60, respectively). Although the cost of gain was least for CON, followed by CB and FP ($P < 0.001), the net profit for the grazing period was greatest for CB and least for the FP ($P = 0.02). If a livestock value price could be established for field peas rather than using the human consumption market value, the field peas would be a more favorable supplementation choice because the value of the animal on FP after grazing was greater than those on CON ($P = 0.04). Similar results were found by Rolfe et al. (2012), who reported supplementing steers on pasture during the summer increased returns after grazing over those cattle that were not supplemented. Jenkins et al. (2009) also noted the cost of the additional gain due to supplementation with distillers grains on dormant native range resulted in an increased value of the steer if the steer was sold at the end of that grazing period.

There were no interactions of grazing and finishing treatment nor an effect of finishing treatment observed for any of the measured feedlot period–related costs, values, or profits ($P ≥ 0.30; Table 6). However, growing treatment had an effect on cost of gain, live net profit, and dressed net profit, with a tendency to differentiate the finished live and dressed animal value (Table 7). Cost of gain favored the CON growing treatment, which was less than CB and FP ($P ≤ 0.01), which did not differ ($P = 0.64). Both live net profit and dressed net profit ($/head) were more desirable for the CON cattle, with positive returns that were significantly different from the FP ($P ≤ 0.01). Cattle supplemented CB were similar to both the CON and FP ($P > 0.06, $P ≥ 0.06, respectively). Similarly, Gillespie-Lewis et al. (2016) reported spayed heifers supplemented during winter cornstalk grazing, and not supplemented during summer grazing, finished out as the most profitable heifers. In that study supplementing at 0.6% BW during the summer grazing period resulted in no final economic benefit from summer supplementation. Jenkins et al. (2009) noted that when distillers grains was...
supplemented at 0.5% BW on dormant native range, the economic benefit of that gain was realized through wheat pasture grazing even though nonsupplemented cattle experienced compensatory gain.

Although the supplemented cattle tended ($P = 0.06$) to be more profitable at the end of the grazing period, even with costs associated with labor and feed, the amount of compensatory gain the CON cattle experienced during finishing offset the increased value of the supplemented cattle without having the associated increased costs. However, for this analysis, the field pea price was determined by the human consumption market. If a discounted price for field peas rejected in the human consumption market could be established, then a more favorable cost of gain could be realized. Drouillard and Kuhl (1999) suggested that knowing when compensatory gain will occur can allow for better allocation of high and low value inputs at the proper time into the production system.

**IMPLICATIONS**

Field peas were an acceptable supplement option for grazing cattle on cool-season pasture; cattle will potentially perform better than those cattle receiving no supplement. In finishing diets, field pea inclusion did not affect performance up to 20% inclusion rate. However, cattle receiving supplement on grass may gain less during the finishing phase, demonstrating the effects of compensatory gain.

**ACKNOWLEDGMENTS**

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**LITERATURE CITED**


Field peas in beef cattle growing and finishing diets


