Effects of growth-promoting implants administered during the suckling phase on growth, conception rates, and longevity in replacement beef heifers grazing native range

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Transl. Anim. Sci. 2018.2:S180–S184 doi: 10.1093/tas/txy048

INTRODUCTION

Successful development of replacement heifers results in heifers becoming pregnant early in the breeding season, calving by 24 mo of age, and maintaining a 365-d calving interval (Lesmeister et al., 1973; Hohenboken, 1988). Attainment of puberty prior to the first breeding season is crucial to ensure high conception rates (Byerley et al., 1987; Patterson et al., 1992; Vraspir et al., 2013). BW is a major contributing factor to attainment of puberty, therefore, BW gains over the development period are of major concern (Patterson et al., 1992).

Recently, heifer development strategies have focused on increasing economic efficiency through reducing inputs, delaying weight gains without impacting reproduction (Lynch et al., 1997). Growth-promoting implants have been utilized in beef production systems to increase BW gains and feed efficiency, and could be a potential option for increasing efficiency in production systems. However, growth-promoting implants have not been recommended for use in replacement heifers due to potential detrimental effects on fertility and subsequent reproductive performance. Ralgro and Synovex C have been reported to increase BW gains and yearling pelvic area (Staigmiller et al., 1983; Hancock et al., 1994). However, previous reports are inconsistent with regard to the effect of growth-promoting implants on pregnancy rates. With some authors reporting no differences between heifers receiving growth-promoting implants compared with non-treated controls (Hancock et al., 1994; Devine et al., 2015), while others report a reduction in pregnancy rates (Staigmiller et al., 1983). To our knowledge, no report has investigated the influence of growth-promoting implants administered during the suckling phase on beef heifers developed on native range and its impact on subsequent longevity. Therefore, we hypothesized that heifers receiving a growth-promoting implant would have increased weaning weights, while having similar overall reproductive efficiency and survivability in grazing beef heifers.

MATERIALS AND METHODS

All animal procedures and facilities were approved by the New Mexico State University Institutional Animal Care and Use Committee.

Animals, Diets, and Treatments

Over the course of 4 yr, 161 spring-born Angus-crossbred heifers were used in a completely
randomized experiment to compare utilization of growth-promoting implants on developing heifers grazing dormant native range at the New Mexico State University Corona Range and Livestock Research Center (CRLRC) located 13 km east of Corona, NM (34°15′36″N, 105°24′36″W). Heifers were randomly assigned to one of two treatments at approximately 3 mo of age at branding: 1) non-implanted controls (CON); or 2) implant (IMP) with heifers receiving a growth-promoting implant (100 mg progesterone + 10 mg estradiol; Synovex C; Zoetis Animal Health, Florham Park, NJ). Heifers were offered supplements as needed after weaning to provide a minimum ADG of 0.09 kg/d.

Rangeland pasture vegetation is described by Forbes and Allred (2001). Heifers had unlimited access to water and a loose salt-mineral mix formulated to complement available forage. The loose salt-mineral was composed of 10% Ca, 7% P, 2% Mg, 0.5% K, 2,500 ppm Cu, 5,000 PPM Zn, 2,500 ppm Mn, 75 ppm I, 15 ppm Se, and 246 KIU/kg vitamin A (Hi-Pro Feed, Friona, TX).

**Blood Collection and Radioimmunoassay**

A single blood sample was collected every 14 d beginning 56 d prior to breeding in years 1 and 2 and 90 d prior to breeding in years 3 and 4. Samples were collected via coccygeal venipuncture into serum separator vacuum tubes (Corvac, Kendall Healthcare, St. Louis, MO). Samples were allowed to clot at room temperature for approximately 2 h then subjected to centrifugation at 1,200 × g for 20 min at 4 °C. Serum was harvested and stored at −20 °C until assayed. Serum progesterone (P4) concentrations were quantified by radioimmunoassay using components of a solid phase kit (MP Biomedicals, LLC, Santa Ana, CA) and modified for use in ruminant serum as reported by Schneider and Hallford (1996). Intra-assay and interassay coefficients of variation were less than 11.5%. Heifers with serum P4 > 1.0 ng/mL were considered pubertal (Henricks et al., 1971).

**Breeding**

In years 1 and 2, estrus was synchronized utilizing the Co-Synch + controlled internal drug release device (CIDR) protocol (Eazi-Breed, Zoetis Animal Health) with fixed-time AI. Heifers received an injection of gonadotropin-releasing hormone (GnRH; 100 µg, i.m.) and a CIDR insert for 7 d after which the CIDR was removed and all heifers received a single 5 mL i.m. injection of prostaglandin F₂α (PGF₂α; Lutalyse, Zoetis Animal Health). Heifers were artificially inseminated 54 h after removal of the CIDR. In years 3 and 4, estrus was synchronized utilizing the 7-d CIDR-PG protocol. Heifers received a CIDR insert for 7 d after which the CIDR was removed and all heifers received a single 5-mL i.m. injection of PGF₂α. At time of CIDR removal, an estrus detection aid (Estrotect, MAI Animal Health, Elmwood, WI) was applied. Upon removal of CIDR insert, heifers were placed in a common pasture and estrus detection performed for 5 d following PGF₂α administration. Heifers were AI approximately 12 h after observed standing estrus. Approximately 10 d following the last day of AI, heifers were exposed to bulls for approximately 60 d in years 1 and 2 and 45 d in years 3 and 4. First-service conception rates were determined 30 d after AI by analyzing whole blood for pregnancy specific protein-B (Biopyrn, Biotracking Inc. Moscow, ID). Overall pregnancy rates were determined at a minimum of 30 d after bull removal via blood sample.

**Statistical Analysis**

Data were analyzed utilizing the MIXED and GLIMMIX procedures of SAS (SAS Inst. Inc., Cary, NC). The model included implant treatment, year, and the interaction of implant treatment × year. Pregnancy rates and pubertal status were analyzed using the GLIMMIX procedure of SAS with a binomial distribution and a logit link to examine the fixed effect of implant treatment. Survival analysis was performed using the LIFETEST Procedure of SAS to examine the influence of implant treatment on lifetime productivity. A P ≤ 0.05 was considered significant. No treatment × year interaction was detected (P > 0.05) for any parameter measured with the exception of antral follicle counts.

**RESULTS AND DISCUSSION**

**Growth Performance**

Heifer BW and ADG for the development period are reported in Table 1. Heifers receiving growth-promoting implants at 3 mo of age were heavier (P < 0.01) at weaning than control heifers. This agrees with previous research (Deutscher et al., 1986) which reported heifers implanted at branding were heavier than control heifers at weaning. The payout period of Synovex C is 50 to 75 d and is designed to increase growth rate in suckling calves.
under 182 kg, therefore increased BW at weaning were expected. Greater yearling BW ($P < 0.01$) was observed in implanted heifers compared to controls. Hancock et al. (1994) reported greater weaning BW in heifers receiving a growth-promoting implant at 2 mo of age this BW advantage was maintained out to a year of age. In the current study, breeding BW for IMP was 16 kg greater ($P < 0.01$) than CON. ADG did not differ ($P \geq 0.59$) among treatments from weaning to breeding or yearling to breeding. Weaning BW differences remained until breeding due to the lack of differences in post weaning ADG, which is in agreement with the report by Hancock et al. (1994).

### Reproductive Performance

Heifer puberty status, first-service conception rates, and overall pregnancy rates are reported in Table 1. The proportion of heifers attaining puberty prior to the breeding season was similar ($P = 0.54$) among treatments. These data agree with previous research by Hancock et al. (1994), who reported no difference in the percentage of heifers attaining puberty at the start of the breeding season in heifers receiving growth-promoting implants at 2 mo of age compared with nonimplanted heifers.

Heifer antral follicle counts, reproductive tract scores, and uterine horn diameters are reported in Table 2. A treatment × year interaction was found for antral follicle counts. Control heifers receiving no growth-promoting implant in years 3 and 4 had similar antral follicle counts; however, heifers receiving growth-promoting implants in year 4 had greater ($P = 0.03$) antral follicle counts compared to IMP heifers in year 3. Antral follicle count is a prediction tool for measuring fertility and the ovarian reserve. To our knowledge, no previous literature has investigated the influence of the utilization of growth-promoting implants administered during the suckling phase on antral follicle counts in beef heifers. It has been suggested that an inherently high variation in ovary size and the ovarian reserve exists and while the mechanism by which this variation exists is not well understood it can be influenced by many factors including birthweight and maternal environment (Cushman et al., 2009; Ireland et al., 2011). Therefore, the difference in antral follicle counts between implant heifers in years 3 and 4 could potentially be the result of inherent variation of the ovarian reserve among animals and environmental effects. Additionally, reproductive tract scores and uterine horn diameter did not differ ($P > 0.91$) between treatments. Likewise, no differences were observed between treatment for the percent of heifers attaining puberty at breeding ($P = 0.54$) or reproductive tract scores ($P = 0.91$). Heifers receiving a Synovex C implant at 3 mo of age and nonimplanted control heifers had similar ($P = 0.12$) first-service conception rates. Furthermore, there was no difference ($P = 0.30$) in overall pregnancy rates between treatments. Similar reproductive tract scores and pubertal status indicates that implants did not deleteriously impact reproductive development prior to the onset of the breeding season.

Staigmiller et al. (1983) reported day of conception did not differ between treatments. Hancock et al. (1994) conducted similar research, implanting heifers with Synovex C at 2 and 6 mo of age, reporting no differences in first-service or overall pregnancy rate in year 1 but decreased pregnancy rates in heifers implanted at 6 mo of age in year 2. In the current study, reproductive performance between CON and IMP heifers was similar over both the development period and breeding season, indicating no significant detrimental effect of growth-promoting implants on fertility in heifers.

Costs associated with development of replacement heifers are recovered through subsequent calf crops. Therefore, survivability of replacement heifers over multiple calf crops is crucial to producer profitability. Hancock et al. (1994) reported similar second season overall pregnancy rates in cows implanted with Synovex C as calves and nonimplanted controls. Other previous literature has failed to report reproductive performance past the

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**Table 1. Effect of growth-promoting implants administered during the suckling phase on heifer BW, ADG, and reproductive performance**

| Item                        | CON  | IMP  | SEM | $P$ value |
|-----------------------------|------|------|-----|-----------|
| No. of Heifers              | 79   | 82   |     |           |
| BW, kg                      |      |      |     |           |
| Weaning weight              | 220  | 234  | 3   | <0.01     |
| Yearling weight             | 239  | 253  | 4   | <0.01     |
| Breeding weight             | 267  | 283  | 4   | <0.01     |
| ADG, kg/d                  |      |      |     |           |
| Yearling to breeding        | 0.50 | 0.52 | 0.03| 0.59      |
| Total                      | 0.21 | 0.21 | 0.01| 0.66      |
| Pubertal, %                 | 64   | 68   | 5   | 0.54      |
| First-service conception rate, % | 45   | 58   | 6   | 0.12      |
| Overall pregnancy rate, %   | 97   | 94   | 3   | 0.30      |

*CON = heifers received no growth-promoting implants at 3 mo of age.
IMP = heifers received a single Synovex C implant at 3 mo of age.
$P$ from weaning to the start of the breeding season.
Heifers with a single serum P4 sample >1.0 ng/mL prior to the start of the breeding season were considered pubertal.
Table 2. Effect of growth-promoting implants administered during the suckling phase on heifer antral follicle count, reproductive tract score, and uterine horn diameter in years 3 and 4

| Item                        | CON* | IMP† | SEM  | P value |
|-----------------------------|------|------|------|---------|
| No. of Heifers             | 21   | 36   |      |         |
| Antral follicle count       |      |      |      |         |
| 2014                       | 23.6 | 19.9 | 1.8  | 0.22    |
| 2015                       | 21.4 | 27.6 | 3.2  | 0.22    |
| Reproductive tract score²  | 4.55 | 4.53 | 0.19 | 0.91    |
| Uterine horn diameter      | 7.41 | 7.47 | 0.51 | 0.91    |

*CON = heifers received no growth-promoting implants at 3 mo of age.
†IMP = heifers received a single Synovex C implant at 3 mo of age.
²Reproductive tract score (Martin et al., 1992).

IMPLICATIONS

Utilization of growth-promoting implants in beef heifers during the suckling phase can increase efficiency through increased BW at weaning without causing detrimental effects on reproductive performance of heifers that will potentially be retained as replacement animals. These results indicate implants can potentially be integrated into production systems without hindering reproductive performance and function as a heifer, as well as through subsequent calving seasons. Furthermore, the additional BW at weaning gained from use of growth-promoting implants is advantageous for producers making replacement heifer selection decisions at weaning, providing additional marketing options and potential profit advantages for heifers not retained as replacements.

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