BEEF CATTLE RESEARCH UPDATE

Britt Hicks, Ph.D., PAS
Area Extension Livestock Specialist
Oklahoma Panhandle Research & Extension Center

June 2018

Impacts of Stocking Density on Growth and Puberty Attainment of Replacement Beef Heifers

Public scrutiny of beef production systems is growing rapidly, and cattle welfare is one of the main targets for attention.[1] Thus, cattle producers are challenged with improving production efficiency while fostering animal well-being. Stocking density is one example of management that may impact welfare and productive efficiency in cattle operations. In spring-calving cow-calf herds, replacement heifers are weaned in the fall and exposed to their first breeding season the following spring. Hence, these heifers are frequently developed in drylot systems to facilitate feeding and management during the fall and winter. However, research has shown that raising cattle in areas with elevated stocking density stimulates stress reactions[1], while acute and chronic stress directly impairs reproductive function in beef cattle.[2] Montana research has reported that heifers developed in drylot (~118 sq ft/heifer) compared to heifers developed on native range (~1.8 acres/heifer) gained over two time more body weight (BW; ~84 vs 33 lb; $P < 0.05$).[3] However, heifers developed in drylot had greater average or resting heart rates and spent less time loafing than heifers developed on native range. Research out of New Mexico has also shown that heifers developed in drylot had greater average daily gain (ADG, 1.52 vs. 0.58 lb/day; $P < 0.01$), but reduced pregnancy rates (84 vs. 91%; $P < 0.10$) compared with cohorts reared on range pastures.[4]

Oregon State University researchers hypothesized that elevated stocking density impairs welfare and reproductive development in beef heifers.[5] To test their hypothesis, they compared growth, physical activity, stress-related and physiological responses, and puberty attainment in heifers developed on high (drylot) or low (pasture) stocking densities from weaning until the start of their first breeding season. In this experiment, 60 Angus x Hereford heifers averaging 210 days of age and weighing 485 lb were assigned to two stocking density treatments for 182 days: drylot (~150 sq ft/heifer) or pasture (~6.2 acres/heifer) . The pastures were harvested for hay prior to the beginning of this experiment, and negligible forage was available for grazing throughout the experimental period. Thus, all heifers (both treatments) were limit-fed daily a diet consisting of 8.8 lb of alfalfa hay and 6.6 lb of corn (both on dry matter basis) along with ad libitum access to water and a commercial mineral/vitamin mix.

Heifers were fitted with a pedometer fixed behind their right shoulder and weekly pedometer results were recorded and blood samples were collected for puberty evaluation via plasma progesterone. On days 0, 49, 98, 147, and 182 of the experiment, hair samples were collected from the tail switch for analysis of hair cortisol concentrations. Cortisol concentration in hair from the tail switch have been validated as a biomarker of chronic stress in cattle given that cortisol is gradually accumulated in the emerging tail hair.

There were no significant differences between treatments for final heifer BW (786 lb) and ADG (1.71 lb/day) during the 182 day trial. However, heifers on pasture took more steps per week than drylot heifers (19,839 vs, 3,147; $P < 0.01$). This outcome was expected since the pasture heifers had more space to roam. Hair cortisol concentrations were greater ($P < 0.01$) for drylot than pasture heifers beginning on day 98 indicating the drylot heifers experienced more chronic stress.

Drylot heifers experienced delayed puberty attainment compared with pasture heifers (Figure 1) despite their similar ADG. At the end of the trial, a greater ($P < 0.01$) number of pasture heifers were pubertal compared to drylot heifers (66.5 vs. 31.9%). It was reported that within heifers that reached puberty during the experiment, drylot heifers were heavier (820 vs. 703 lb; $P = 0.05$) and older (363 vs. 328 days; $P < 0.01$) than pasture heifers at puberty attainment.

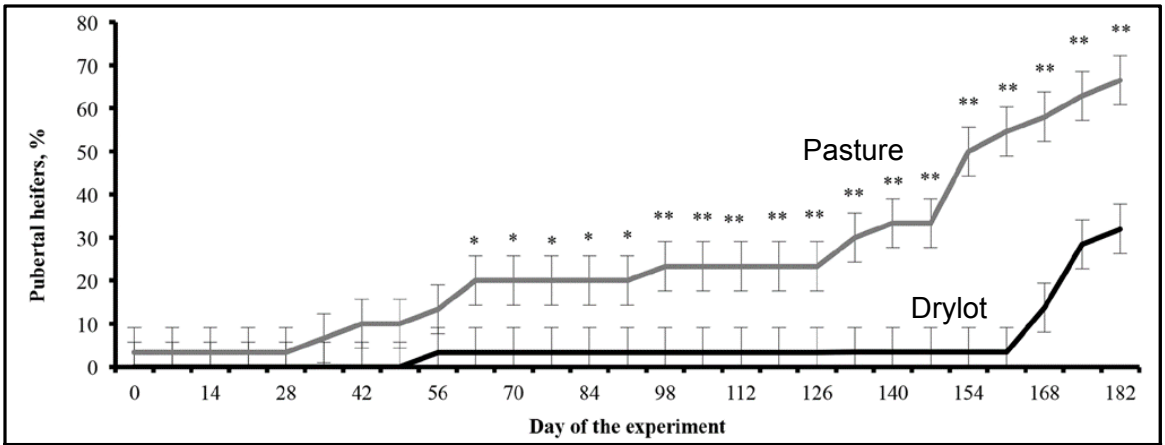

Figure 1. Puberty attainment in heifers reared in low stocking density (pasture, ~6.2 acres/heifer) or high stocking density (drylot, ~150 sq ft/heifer) from day 0 to 182 of the experiment. A treatment × day interaction was detected ($P < 0.01$). Within days, ** $P \leq 0.01$. Adapted from Schubach et al., 2017.

These authors concluded that "rearing replacement beef heifers in drylot with high stocking density negatively impacted stress-related and physiological responses, and delayed puberty attainment compared with rearing heifers in pastures with low stocking density. In addition, these results were independent of heifer nutritional status and growth rate, but were associated with reduced physical activity and increased chronic stress caused by high stocking density." Thus, stocking density should be considered in heifer development programs to optimize reproductive and overall efficiency of cow-calf operations.

---

[1] Grandin, T. 2014. Livestock handling and transport. 4th edition. Wallingford: CABI Publishing.

[2] Dobson, H. and R.F. Smith. 2000. What is stress and how does it affect reproduction? Anim. Repro. Sci. 60-61:743-752.

[3] Petersen, M. K., J. M. Muscha, A. J. Roberts, and R. C. Waterman. 2014. Can method of weaning and subsequent development impact heifer fitness? Proc. West. Sec. Am. Soc. Anim. Soc. 65: 116-119.

[4] Mulliniks, J. T., D. E. Hawkins, K. K. Kane, S. H. Cox, L. A. Torell, E. J. Scholljegerdes, and M. K. Petersen. 2013. Metabolizable protein supply while grazing dormant winter forage during heifer development alters pregnancy and subsequent in-herd retention rate. J. Anim. Sci. 91: 1409-1416.

[5] Schubach, K. M., R. F. Cooke, A. P. Brandão, K. D. Lippolis, L. G. T. Silva, R. S. Marques, and D. W. Bohnert. 2017. Impacts of stocking density on growth and puberty attainment of replacement beef heifers. Proc. West. Sec. Am. Soc. Anim. Soc. 68: 15-20.