ABSTRACT

In the wake of global climate change, it is paramount that breeders use breed types with optimal performance ability. This investigation describes a unique 3-breed composite population of cattle in south Texas composed of Red Angus and tropically adapted Senepol and Tuli breeds. Under a low-input production system, trend analyses revealed that between 2005 and 2015 total direct costs per cow decreased by $180 due largely to reduction of feed costs ($-9.40 ± 4.3 $/yr; P < 0.10). Despite years of serious drought, adopting increasingly conservative stocking rates, and decreasing mean weaning weights, profit per cow and per hectare were realized every year. Significant interaction existed between coat type of calf and color of calf and dam for weaning weight (n = 183 calves and 50 dams). For the light calf–light cow color cohort, slick compared with hairy coated calves differed by only 0.31 ± 12.5 kg (P > 0.05). However, where either or both the calf and dam were red colored, a larger combined mean difference of 14.3 ± 5.2 kg (P < 0.05) favored slick over hairy calves. For preweaning traits, estimates of direct and maternal breed additive effects were obtained for all 3 breeds. Direct and maternal heterosis effects for birth weight were negligible (3.1 and 1.6%, respectively). However, direct heterosis effects were more important for weaning weight and preweaning growth of 32.7 kg (12.5%) and 0.074 kg/d (6.7%), although the maternal heterosis effect on weaning weight was small (1.4%). Chi-square analyses revealed (P < 0.01) that about 1.5 times more bull than heifer calves were born (n = 252) when conceived in summer. Overall, results of this experiment warrant further research.

Key words: beef cattle, crossbreeding parameters, preweaning growth, slick gene, sex ratio

INTRODUCTION

For well over a century, major breeding efforts have been made in the Gulf Coast region to introduce and evaluate potentially adaptable breeds or biological types of cattle that can cope with the subtropical climate, infestation by parasites, and periodic and severe droughts, among other challenges (Rhoad, 1955). These efforts have widely involved the application of crossbreeding. In more recent years, a plethora of papers have been published on aspects of sustainability (e.g., reducing carbon footprints and matching breeding and management practices with natural ecological phenomena). Moreover, in the wake of global climate change, it will likely become an even greater challenge to produce food to meet the demands of a rising human population (Nelson et al., 2009; Scasta et al., 2015; Ault et al., 2016; Davis et al., 2017).

A beef ranch located in south Texas has since 2005 been breeding for a more heat- and drought-tolerant type of cattle that involves a composite of Red Angus, Senepol, and Tuli breeds. The composite-bred cattle are mostly slick coated and light colored and are managed under a low-input production system involving sustainable management practices such as summer breeding and mid-spring calving, wintering calves on dams, stockpiling forage or rotational grazing (to avoid feeding hay), grass-fed beef production, applying no chemical fertilizers to pastures, and using tropically adapted African genetics and available heterosis while selecting for moderate rather than extreme phenotypes with regard to optimal performance. Several of these practices are consistent with global efforts to mitigate the negative environmental impact of beef cattle production (Capper, 2011; FAO, 2013).

The research objectives were as follows: (1) to analyze trends involving costs versus profit per cow and per hectare; (2) to estimate the effects of coat type (slick vs. hairy)
and color genes (light vs. red) on weaning weight; (3) to estimate direct and maternal breed additive and heterosis effects on preweaning growth traits; and (4) to test for distortion of sex ratio involving several years of maintaining a summer breeding program in south Texas.

MATERIALS AND METHODS

Study Site and Environment

The study was conducted on a privately owned ranch located in Kingsville, Texas, in the southernmost and subtropical region of Texas (27°23′25″N, 97°49′33″W). Average precipitation for this region is approximately 55 cm; however, since 1950 about 2 in every 5 yr have been marked by drought (Bryant, 2009). A herd consisting of approximately 50 cows grazed pastures on mostly sandy loam soils. Most land was leased, with total land area used for grazing ranging between approximately 135 and 200 ha in most years. Pastures largely consisted of exotic grasses, especially bermudagrass (Cynodon dactylon), guineagrass (Urochloa maxima), and Kleberg bluestem (Bothriochloa ischaemum), although several native species exist but were less abundant in terms of pasture composition. In good years, forage quantity can be as high as 5,000 kg/ha. Pastures were not chemically treated with fertilizers or herbicides for weed control, although encroachment of brush (e.g., Acacia farnesiana and Prosopis glandulosa) was controlled annually using herbicides via individual plant treatment.

In terms of pasture management, cattle were regularly rotated through pastures ranging in size from approximately 2 to 35 ha. Grazing as well as rest periods were usually between 3 wk and 3 mo, although grazing more than 50% of available forage was avoided. Stocking rate was generally about 1 animal unit per 4 ha, but in exceptional years of drought it was as low as 1 animal unit per 6.5 ha. In south Texas, most winters were mild without hard freezes, with green forage being available, eliminating the need for energy or protein supplements, although mineral and vitamin supplements were provided. In addition, hay has not been fed since 2001 due to the practice of stockpiling forage and maintaining low stocking rates. Additional details on forage management are reported by Ortega et al. (2013).

Cattle Breeding Management and Breeds Used

One pivotal management objective is to work closely with nature with calving occurring in mid-spring, mostly in May. This allowed cows to recoup their body condition by consuming early spring grass before calving, which emulates behaviors of wild large herbivores such as bison and deer. However, this decision necessitated a 45-d breeding season from mid-July through August (practiced since 2008). Historically, these 2 mo tend to have the least precipitation (between May and October) and the highest temperatures for the region (Nielsen-Gammon, 2011; NOAA, 2017). Effects of heat stress negatively affect cattle fertility and embryonic survival in the Gulf Coast region (Hansen, 2013).

To address this and other environmental challenges, 2 tropically adapted, Bos taurus breeds—Senepol and Tuli—were introduced via AI and as natural service sires into the original commercial-based herd (e.g., Beefmaster and Santa Gertrudis crossbreds) between 2003 and 2004, as well as Red Angus. The Senepol and Tuli breeds were chosen based, in part, on reports from breeding studies conducted in the Gulf Coast region that showed favorable performances relative to other tropically adapted breeds and crossbreds (Chase et al., 1998; Hammond et al., 1998; Herring et al., 2005; Holloway et al., 2005; Phillips et al., 2005).

The Senepol breed was developed on St. Croix Island in the early 20th century and was developed from a foundation of N’Dama cattle from Senegal, West Africa. Of relevance to this study, Senepol cattle are red in color and possess a dominant gene for slick hair coats (PRLR p.Leu462* mutation on chromosome 20; Littlejohn et al., 2014). In addition, Senepol display numerous vertical skin folds, especially in the neck region, which increase body surface area. Studies conducted in Florida by Hammond and Olson (1994) and Hammond et al. (1996) demonstrated that Senepol and Brahman purebreds had similar heat tolerance ability when measured during summer.

The Tuli breed originated from tropical southeast Africa. Tuli cattle possess red, white and dun genes for coat color. To briefly explain these genes, all Tulis are homozygous for the red gene [presumably MC1R (melanocortin 1 receptor) as found in Red Angus] and of course have red coats (Lukefahr, 2007). A separate locus, a dilution or white gene (pre-melanosomal protein deletion, PMEL) is found on chromosome 5, involves co-dominant expression, and based on the gene’s base-pair sequence, appears to be the same allele as found in Galloway and Highland cattle (Davis et al., 2017). An animal without a white gene is red, with 1 white gene is yellow (due to co-dominance), and with 2 white genes is white. Hence, there is epistatic interaction between genes at these 2 loci. In contrast to red and white genes, the dun dilution gene (which appears to be recessive) is not always apparent at birth. Neonates that are yellow typically soon fade to light yellow or even almost white, seemingly depending on whether they possess 1 or 2 copies of the dun gene (Lukefahr, 2007). Schmutz and Dreger (2013) reported on a dun gene in Highland cattle that has similar semi-dominant expression, although the dun gene found in the Tuli breed has yet to be mapped and sequenced.

In the present study involving data collected from 2005 through 2015 (n = 183), several sires and dams were heterozygous for coat type and color genes. To illustrate, slick × slick or slick × hairy matings could produce slick and hairy calves, and red × yellow matings produce red and yellow calves, and yellow × yellow matings produce red, yellow, and white calves. Red and yellow calves could be...
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