Adapting Bulls to Florida

Chad Chase[1] and Peter Chenoweth[2]
[1]Research Animal Scientist, USDA, ARS, Subtropical Agricultural Research Station, Brooksville, FL
[2]Professor, School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga, Australia

Introduction

The adaptation of bulls used for natural breeding purposes to the Gulf Coast region of the United States including all of Florida is an important topic. Nearly 40% of the U.S. cow/calf population resides in the Gulf Coast and Southeast. Thus, as A.I. is relatively rare, the number of bulls used for natural service is an extremely high number. Although there are a number of seedstock producers in the region, other more northern regions are also well known for bull production of temperate adapted breeds in particular. Due to the high demand for breeding bulls in Gulf Coast states there may be times when bulls are purchased from outside the region and hence were born and raised in another more temperate climate. These bulls are referred to as "introduced" or "unadapted" in contrast to "local" or "adapted" bulls. The subtropics include the Gulf Coast region and this is a relatively stressful environment. Adaptation to, or tolerance of, a variety of stressors including heat, humidity, disease, parasite burden, and low quality forage are important attributes. The genotype by environment interaction (GEI) is related to adaptation and was clearly demonstrated in exchanges of Hereford cattle between Montana and Florida. These studies documented differences in productivity between Montana and Florida Hereford cattle and demonstrated that these differences favoured the local vs. introduced Hereford over generations. Therefore, this paper will first describe the results of those GEI studies specifically for bulls, second will describe results of a few other studies that evaluated reproductive performance of bulls in the subtropics or tropics, third will emphasize the importance of acclimation and quarantine, and fourth will discuss multiple sire breeding and bull to female ratio.

Genotype by Environment Interaction

A series of papers were published on the subsequent productivity of Hereford cattle exchanged between Montana and Florida (Butts et al., 1971; Koger et al., 1979; Burns et al., 1979; Pahnish et al., 1983, 1985). One paper specifically described the postweaning development of bulls (Pahnish et al., 1985). For phase 1, Hereford cattle from Montana (Line 1) were swapped with Hereford cattle from Florida (Line 6). The weaning weights (actual and 205-day adjusted) of bull calves born from 1966 to 1973 were for Line 1 in MT 408 and 461 lb, Line 6 in MT 386 and 434 lb, Line 1 in FL 412 and 401 lb, and Line 6 in FL 456 and 443 lb. Actual weaning weight was influenced by line and location, but 205 day adjusted weaning weight was influenced by location only and not by line. For origin (line x location), there was a 33 lb advantage for local over introduced bulls in both actual and 205 day adjusted weaning weight. For the postweaning test, nutritional diets and length of test markedly differed between locations (age at end of test in MT 394 days and in FL 586 days). End test weight and postweaning daily gain were for Line 1 in MT 981 lb and 2.72 lb/day, Line 6 in MT 897 lb and 2.43 lb/day, Line 1 in FL 996 lb and 1.60 lb/day, and Line 6 in FL 1043 lb and 1.60 lb/day. Line and location were significant for end test weight and postweaning daily gain (as well as for condition score, confirmation score, and forecannon circumference). For origin (line x location), there was a 66 lb advantage for end test weight and 0.15 lb/day advantage in postweaning daily gain for local over introduced bulls. Thus, about one half of the advantage seen in end test weight occurred from birth to weaning and the other one half occurred from weaning to the end of test.

In phase 2 (which overlapped with phase 1), base herds of Line 1 Herefords were established in both Montana and Florida. Line 1 Hereford bulls produced in Montana were used to breed one herd in Montana and another one in Florida, and bulls from Line 1 Montana cows were selected in Florida, Line 4, and used on one herd in Florida and one herd in Montana.

Thus, the progeny are from more related lines than in phase 1 and were born from 1967 to 1974. Actual weaning and adjusted 205 day weights for Line 1 in MT were 417 and 474 lb, Line 4 in MT were 408 and 456 lb, Line 1 in FL were 386 and 381 lb, and Line 4 in FL were 408 and 399 lb. Location but not line affected actual weaning and adjusted 205 day weights. Origin (line x location) favoured local over introduced bulls by 15 lb actual weaning and 18 lb adjusted 205 day weight. Postweaning diets and length of postweaning test differed between locations so that the average age at the end of the test in Montana was 394 days and in Florida was 586 days. By the end of the postweaning period, body weight and daily gain for Line 1 in MT were 988 lb and 2.71 lb/day, Line 4 in MT were 970 lb and 2.66 lb/day, Line 1 in FL were 954 lb and 1.56 lb/day, and Line 4 in FL were 999 lb and 1.62 lb/day. Location was significant for postweaning daily gain but not end test weight and line was not significant for either. Origin (location x line) was significant for both end test weight (31 lb) and postweaning daily gain (0.05 lb/day) for local over introduced bulls.

Reproductive Performance of Adapted and Non-Adapted Bulls in the Subtropics (Florida) and Tropics

An additional but related study was reported on bulls from Brooksville, Florida (Fields et al., 1979). Montana Line 1 and Florida Line 6 Hereford bulls were evaluated in April and August (approximately 16 and 20 months of age). Weight gains were slightly less for Montana Line 1 (159 lb) than Florida Line 6 (172 lb) bulls. Both Hereford Lines decreased in testicular volume during summer; however, the decrease was more severe for Montana Line 1 (-55 cm^3) than Florida Line 6 (-25 cm^3). Semen volume and sperm motility also decreased for both Hereford lines but decreased more for Montana Line 1 (-1.2 mL and -16%) than Florida Line 6 (-0.4 mL and -1%) bulls. Lastly, from April to August, sperm concentration decreased in the Montana Line 1 (-74 x 10^6/mL) and increased in Florida Line 6 bulls (97 x 10^6/mL). These results indicate a depression during summer (high humidity and hot temperature) in Montana Line 1 bulls that included testicular volume, semen volume, sperm motility, and ultimately sperm concentration. In Florida Line 6 bulls, less or no depression occurred and sperm concentration was enhanced. It should be noted that sperm concentration should normally be increasing in developing bulls from 16 to 20 months of age. Thus, environment seemed to affect the reproductive development of Montana Line 1 bulls in Florida.

Growth and semen traits were evaluated for Angus and Senepol bulls fed 75% (LOW) or 150% (HIGH) of the maintenance requirements for metabolizable energy (ME) and similar protein from June through September in Brooksville, Florida (Chase et al., 1993). Angus bulls fed LOW lost 60 lb and Angus bulls fed HIGH gained 104 lb, whereas, Senepol bulls fed LOW gained 9 lb and Senepol bulls fed HIGH gained 183 lb. Similar trends for greater growth in Senepol than in Angus bulls were observed for backfat thickness, ribeye area, scrotal circumference, and paired testicular volume. These growth traits all tended to be lower for Angus than Senepol during summer and were most dramatic (as losses) in Angus bulls fed the low diet. Semen traits indicated that gross motility scores and individual motility declined in Angus and increased in Senepol, and that total abnormalities (primary and secondary) increased in Angus but did not change or slightly declined in Senepol. This suggests that the environment, high humidity and hot summer temperatures, adversely affected the unadapted Angus to a greater degree than the adapted Senepol.

In northern Australia, Fitzpatrick et al. (2002) evaluated Brahman, 5/8 Brahman, and Santa Gertrudis bulls (n = 322) for semen traits and their relationship to calf output. These authors concluded that 1) semen examinations including sperm morphology should be incorporated into bull selection programs and premating examinations to ensure that bulls have a threshold of 70% normal sperm, 2) fertility recommendations should not be based solely on semen or sperm motility, and 3) assessments of semen heparin-binding protein profiles are unlikely to enhance bull fertility.

Acclimatization and Quarantine of Newly Purchased Bulls

The process of acclimatization and quarantine is an important period for several reasons. Firstly, it enables the bull to adapt to his new environment (temperature, feed, water, “germs and bugs”), secondly, it enables the owner to quarantine new bulls and observe them for any signs of disease (as well as other problems), and thirdly, it provides an opportunity to get the new bull into the same health program as the rest of the herd (vaccinations, parasite control, etc.).

Re-location and associated adaptation problems are frequently not diagnosed until bulls have resided on the property for some time. Then the problems are often represented by reduced pregnancy rates or delayed and strung-out calvings. Although the causes of such problems may be multiple, and the effects both real and perceptual, recommendations to minimize the risk of this occurring have been made (McCool and Holroyd, 1993) as follows:

- Purchase locally produced bulls when possible.
- Purchase or transport bulls from afar when conditions are optimal at the new site (e.g., when pastures are good, parasites are on the decline, etc.).
- Introduce bulls to their new environment gradually by holding and feeding them in pens initially, then releasing them into small pastures under supervision.
- Purchase yearling bulls so that they have time to acclimate to the environment before maturity (also they will better adapt to one another socially).

Multi-Sire Breeding and Bull-to-Female Ratio

Bull-to-female (BFR) ratios of 1:20 to 1:30 have traditionally been recommended; however, these ratios under estimate the capabilities of competent bulls. A study compared single- and multi-sire systems with Hereford bulls at BFR of 1:25, 1:44 and 1:60 (Rupp et al., 1977). They reported that the fertility, libido, and mating ability of individual sires were more important than either BFR or single- vs. multi-sire breeding systems. Similarly, in northern Australia, there was no difference in reproductive rates between single- and multi-sire herds studied over a period of 18 years (Bamualim et al., 1984). In Colorado, yearling Hereford bulls which had been pre-assessed for BSE and libido were compared at BFR of 1:20 and 2:40 with estrus synchronized crossbred heifers (Farin et al., 1982). Overall, bull mating performance and pregnancy rates did not differ between BFR. Comparison of a variety of single-sire BFR (1:7 to 1:51), also with estrus synchronized females, found that BFR was not a limiting factor to fertility, even at the lowest BFR (Pexton et al., 1990). In Northern Australia, no difference was observed in herd fertility when reproductively sound Brahman bulls were used at BFR of either 1:17 or 1:40 (Fordyce et al., 1998). Two studies conducted in vastly different environments showed that bulls screened for BSE increased herd pregnancy rates at reduced BFR (1:20 to 1:33; Prince et al., 1987; McCosker et al., 1989).

Thus, it is apparent that sound bulls which have passed a BSE can handle considerably more females during a generic breeding season than traditional recommendations would suggest. It is also evident that most producers have yet to take full advantage of these findings. For example, US surveys indicate that cattle breeding operations overall use yearling bulls at 1:17.5 and mature bulls at 1:25; figures which have changed little in recent years (USDA, NAHMS 1998). Cattle breeders in the Rocky Mountain region used a mean BFR of 1:21, with 25% of the herds using a BFR of <1:18 (Sanderson and Gay, 1996). Belated recognition of the capabilities of competent bulls has come with more recent US industry recommendations for bull ratios of 1:40 (mature) and 1:15 to 20 (yearling; Ewbank, 1996).

Likewise, in the tropics (Northern Australia), there is considerable evidence to support the lowering of bull percentages from the industry average of 5% (1:20; Bamualim et al., 1984; Holroyd et al., 2002) to one-half that number of bulls (2.5%; 1:40) without compromising herd fertility (Holroyd et al., 2002; McCosker et al., 1989). The latter obtained better results with 3% (1:33) tested bulls than 5% (1:20) untested bulls. When investigating 20 years of infertility in extensively managed herds, McCool and Holroyd (1993) could identify only two instances when lowered bull percentages or BFR accounted for reduced fertility in the cow herd. Some advantages associated with lower bull percentages have included less variance in calf output and less bull attrition due to injury (Fordyce, et al., 2002).

Summary/Conclusions

Results of GEI studies demonstrated that for growth traits of bulls, origin i.e., local vs. introduced, both preweaning and postweaning growth was greater for local than introduced Hereford lines. This information at least for growth and development of bulls would indicate the importance of purchasing bulls born and raised in a similar region as they will be used. Furthermore, when bulls from Montana and Florida were evaluated during summer in Florida, both growth and semen traits were affected adversely in Montana but not Florida line bulls. This is important because a depression in semen traits can adversely affect reproductive performance. Semen traits were also adversely affected during summer in Angus (unadapted) compared to Senepol (adapted) bulls in Florida. In the tropics, researchers concluded that bull selection and premating criteria should have a threshold of 70% normal sperm.

As far as the selection and use of bulls for Florida, many of the traits would be similar whether the bulls were local or introduced. New bulls should go through a period of acclimatization and quarantine. For introduced bulls, greater care premating and postmating may be necessary to keep adequate condition scores on the bulls. More than likely, the breeding season will not coincide with the worst hot and humid months and careful maintenance prior to the breeding season will ensure adequate body condition going into the breeding season. During the hot and humid summer months, adequate water and shade is important. Selection of bulls based on EPDs, pedigree, structural conformation, and positive results from a breeding soundness examination (BSE) including analysis of semen traits is necessary. All bulls should be re-examined and a BSE conducted at least 60 days prior to the start of the breeding season so that any bulls with a deferred score can be re-examined before the beginning of the breeding season. Trends are to use lower BFR than in the past, and competent bulls screened for BSE should be able to accomplish the job at 1:40 for mature bulls and 1:15 to 20 for yearling bulls.

Literature Cited

Bamualim, W. R. B., K. W. Entwistle, and M.E. Goddard. 1984. Variation in fertility in *Bos indicus* cross bulls. Anim. Prod. in Austr. 15:263-266.

Burns, W. C., M. Koger, W. T. Butts, O. F. Pahnish, and R. L. Blackwell. 1979. Genotype by environment interaction in Hereford cattle: II. Birth and weaning traits. J. Anim. Sci. 49:403-409.

Butts, W. T., M. Koger, O. F. Pahnish, W. C. Burns, and E. J. Warwick. 1971. Performance of two lines of Hereford cattle in two environments. J. Anim. Sci. 33:923-932.

Chase, C. C., Jr., R. E. Larsen, A. C. Hammond, and R. D. Randel. 1993. Effect of dietary energy on growth and reproductive characteristics of Angus and Senepol bulls during summer in Florida. Theriogenology 40:43-61.

Ewbank, K. 1996. Beyond breeding. Drovers Journal, Sept. issue, pp. 66-70.

Farin, P. W., P. J. Chenoweth, E. R. Mateos, and J. E. Pexton. 1982. Beef bulls mated to estrus synchronized heifers single vs multi-sire breeding groups. Theriogenology 17:365-372.

Fields, M. J., W. C. Burns, and A. C. Warnick. 1979. Age, season and breed effects on testicular volume and semen traits in young beef bulls. J. Anim. Sci. 48:1299-1304.

Fitzpatrick, L. A., G. Fordyce, M. McGowan, J. D. Bertram, V. J. Doogan, J. De Faveri, R. G. Miller, and R. G. Holyroyd. 2002. Bull selection and use in northern Australia: Part 2. Semen traits. Anim. Reprod. Sci. 71:39-49.

Fordyce, G, L. A. Fitzpatrick, J. O'Kane, et al. 1998. Bull selection and use in Northern Australia. 5. Bull:female ratios. Proc. XXth Buiatrics Congress (Australia). Vol.1. pp 413-415.

Fordyce, G., L. A. Fitzpatrick, N. J. Cooper, V. J. Doogan, J. De Faveri, and R. G. Holroyd. 2002. Bull selection and use in northern Australia 5. Social behaviour and management. Anim. Reprod. Sci. 71:81-99.

Holroyd, R. G., V. J. Doogan, J. De Faveri, G. Fordyce, M. R. McGowan, J. D. Bertram, D. M. Vankan, L. A. Fitzpatrick, G. A. Jayawardhana, and R. G. Miller. 2002. Bull selection and use in northern Australia 4. Calf output and predictors of fertility in multiple-sire herds. Anim. Reprod. Sci. 71:67-79.

Koger, M., W. C. Burns, O. F. Pahnish, and W. T. Butts. 1979. Genotype by environmrnt interactions in Hereford cattle: I. Reproductive traits. J. Anim. Sci. 49:396-402.

McCool, C. and R. Holroyd. 1993. Mating Practices. In: Bull Fertility, R.G. Holroyd (Ed.), pp. 50-51. Conference and Workshop Series QC93008, Dep. Of Primary Industries, Brisbane, Australia.

McCosker, T. H., A. F. Turner, C. J. McColl, et al. 1989. Brahman bull fertility in a North Australian rangeland herd. Theriogenology 32:285-300.

Pahnish, O. F., M. Koger, J. J. Urick, W. C. Burns, W. T. Butts, and G. V. Richardson. 1983. Genotype x environment in Hereford cattle: III. Postweaning traits of heifers. J. Anim. Sci. 56:1039-1046.

Pahnish, O. F., J. J. Urick, W. C. Burns, W. T. Butts, M. Koger, and R. L. Blackwell. 1985. Genotype x environment interaction in Hereford cattle: IV. Postweaning traits of bulls. J. Anim. Sci. 61:1146-1153.

Pexton, J. E., P. W. Farin, G.W. Rupp, and P. J. Chenoweth. 1990. Factors affecting mating activity and pregnancy rates with beef bulls mated to estrus synchronized females. Theriogenology 34:1069-1077.

Prince, D. K., W. D. Mickelsen, and E. G. Prince. 1987. The economics of reproductive beef management. Bovine Practitioner 22:92-97.

Rupp, G. P., L. Ball, M. C. Shoop, et al. 1977. Reproductive efficiency of bulls in natural service: Effects of bull to female ratio and single vs multiple sire breeding groups. JAVMA 171:639-642.

Sanderson, M. W. and J. M. Gay. 1996. Veterinary involvement in management practices of beef cow-calf producers. JAVMA 208:488-491.

USDA, NAHMS. 1998. Cow/Calf Health and Productivity Audit. Part IV: Changes in the U.S. Beef Cow-Calf Industry 1993-1997.

Notes: