EFFECT OF CONTRASTING ENVIRONMENTS ON TOTAL YIELD AND LACTATION CURVE CHARACTERISTICS OF COMPOSITE BEEF COWS

R.A Kemp

Agriculture and Agri-Food Canada, Research Centre, Lethbridge, Alberta T1J 4B1

SUMMARY

Milk yield data on 218 lactations from composite beef cows in semi-arid range (MB) and semi-intensive pasture (BR) locations over two years were used to study the effects of year, location, cow age, sex of calf and interactions on lactation yield and lactation curve characteristics. Weigh-suckle-weigh procedures following a 12-hr separation were used to estimate 24-hr milk yield (2 times 12-hr calf weight gain). Year-location interactions were significant ($P<.05$) for lactation curve scale (a) and shape (k) parameters, time of peak lactation (TPL), yield at time of peak lactation (YTPL) but not ($P>.05$) 205-d total yield (TY). Location differences significantly affected a, k, TPL and YTPL. Sex of calf effects significantly ($P<.10$) affected a and TPL. Significant ($P<.10$) cow age effects on a, k, TPL and YTPL were mostly between 2-yr olds compared to 3- and 4-yr old cows. Year-cow age and location-sex of calf interactions were significant ($P=.04$) for YTPL and TPL, respectively. Evaluation of lactation curve characteristics should include an assessment of interactions involving year, location, cow age and sex of calf effects. The trait most closely related to weaning weight, TY was only affected by year and cow age effects. Therefore both of these effects, at a minimum, should be included in genetic evaluation of total lactation yield.

Keywords: lactation curve, beef cows, fixed effects, genetic evaluation

INTRODUCTION

Milk yield in beef cows is one of the most important factors influencing calf weaning weight. Few studies have actually examined lactation curve and yield parameters. Previous studies have examined the effect of breed and energy level on lactation yield and lactation curve parameters (Jenkins and Ferrell 1984, 1992). Rahnefeld *et al.* (1990) and McKay *et al.* (1994) reported somewhat conflicting results for 24-hr milk yield in two contrasting environments. However lactation curves were not used in those studies. Therefore the objective of this study was to compare lactation yield and lactation curve characteristics of a single genotype in two contrasting environments.

MATERIALS AND METHODS

The data for this study were obtained in 1994 and 1995 at each of two locations representing contrasting environments; a semi-intensive pasture (Brandon(BR), Manitoba) and a semi-arid short grass prairie extensive range systems (Manyberries(MB), Alberta). Sixty cows representing a composite genotype (.25 Simmental, .25 Charolais, .44 Hereford and Angus and

.06 Limousin) and ranging in age from 2 to 4 years were available at each location in each year. Milk yield data was collected on approximately days 45, 60, 75, 140 and 195 of lactation. In 1994, at MB milk yield was collected on days 60, 140 and 195only Weigh-suckle-weigh procedures, following a 12-hr separation were used to collect milk yield data. Milk yield (24-hr) was calculated as twice the 12-hr weight gain of the calf. Data were edited such that all cows were required to have a minimum of three positive milk yield observations. Following editing 24-hr milk yield data was available on a total of 218 cows.

Lactation curve parameters for each cow were estimated by regression using the logarithm of the Jenkins and Ferrell (1982) equation. Lactation scale (a) and shape (k) parameters, time of peak lactation (TPL), milk yield at time of peak lactation (YTPL) and 205-d total lactation (TY) were estimated for each cow. Fixed effects of year, location, sex of calf, cow age, all two-way and higher order interactions and covariates for birth date and birth weight of calf, both across and within year and location were evaluated for each trait by analysis of variance. Final models for all traits were $Y_{ijklm} = \mu + YR_i + LOC_j + CAGE_k + SEX_l + YR\text{-}LOC_{ij} + e_{ijklm}$ where Y_{ijklm} = the m th observation on a, k , TPL, YTPL and TY, μ = the overall mean, YR_I = the fixed effect of the ith year, LOC_j = the fixed effect of the jth location, $CAGE_k$ = the fixed effect of the kth cow age class, SEX_l = the fixed effect of the lth sex of calf class, $YR\text{-}LOC_{ij}$ = the interaction effect of YR_i and LOC_j and e_{ijklm} = random error. For TPL and YTPL additional interaction effects $LOC\text{-}SEX_{jl}$ and $YR\text{-}CAGE_{ik}$, respectively were significant (P=.04). The PDIFF option of LSMEANS and the ESTIMATE statement of the GLM procedure were used to compare specific effects interest (SAS 1988).

RESULTS AND DISCUSSION

Coefficients of variation ranged from 21 to 36% and coefficients of determination from the final models ranged from .25 to .38 indicating that there was a moderate amount of variation unaccounted for by the final models.

Year and location effects. The YR-LOC and LOC effects were not significant, (P=.39) and (P=.25), respectively for TY but the YR effect was significant (P<.01). Rahnefeld *et al.* (1990) reported that average 24-hr milk yields were higher at BR than MB for crossbred cows while McKay *et al.* (1994) reported that MB had higher 24-hr milk yield in August and fall milkings but BR had higher yields in spring milking. Least squares means (LSM) for TY (kg) in 1994 and 1995 were 1727.1 ± 33.5 and 1423.2 ± 31.0, respectively. These TY means appear to be similar to those reported by Jenkins and Ferrell (1984, 1992), and Mallinckrodt *et al.* (1993) for purebred and crossbred beef cows. The YR-LOC were significant (P<.01) for all other traits (Table 1). Lactation curve scale parameters were similar (P>.10) at BR in both years and at both locations in 1995. In 1994 at MB a was significantly (P<.05) smaller. The LSM for a were within ranges reported by Jenkins and Ferrell (1984, 1992). Lactation curve shape parameters were significantly different (P<.05) in each year-location subclass and LSM with the exception of 1994 at MB were within the ranges reported by Jenkins and Ferrell (1984, 1992). The BR location had significantly (P<.05) larger a and smaller k values that MB

(Table 1). Jenkins and Ferrell (1992) reported that as energy availability increased a increased and k decreased which agrees with expected energy availability differences at BR and MB. Time of peak lactation varied significantly (P<.05) among year-location subclasses and with the exception of 1994 at BR were within the ranges by Mallinckrodt *et al.* (1993) and Jenkins and Ferrell (1984, 1992). Brandon had significantly (P<.05) later TPL than MB. Jenkins and Ferrell (1992) reported that time of peak lactation was delayed when energy availability increased which was consistent with expected energy availability differences at the two locations. Yield at time of peak lactation was similar (P>.05) among all year-location subclasses except for 1994 at MB where YTPL was significantly (P<.05) larger. Except for 1994 at MB the YTPL least squares means were within the range of values reported by Mallinckrodt *et al.* (1993) and Jenkins and Ferrell (1984, 1992). The MB location had significantly (P<.05) higher YTPL compared to BR which does not agree with the expected results based on Jenkins and Ferrell (1992).

Table 1. Year-location least squares means and location differences for lactation characteristics[A,B]

Year	Location	a	k	TPL (weeks)	YTPL (kg/d)
1994	BR	.44^{a} (.02)	.081^{a} (.004)	12.89^{a} (.35)	10.58^{a} (.38)
1994	MB	.23^{c} (.02)	.141^{b} (.004)	7.62^{b} (.37)	14.27^{b} (.40)
1995	BR	.42^{a,d} (.02)	.100^{c} (.004)	10.56^{c} (.33)	9.80^{a} (.36)
1995	MB	.38^{b,d} (.02)	.114^{d} (.004)	9.30^{d} (.33)	9.77^{a} (.35)
	BR - MB	.125* (.02)	-.037* (.004)	3.26* (.35)	-1.83* (.37)

[A]Locations are Brandon (BR) semi-intensive pasture and Manyberries (MB) semi-arid range.
[B]Lactation curve parameters are a and k which are scale and shape parameters, respectively, time of peak lactation (TPL) and yield at time of peak lactation (YTPL).
[a,b,c,d]Means within column with different superscripts are significantly different (P<.05).
[*]Significantly different from zero at (P<.05).

Other interaction effects. Cows nursing heifer calves at BR reached TPL later (P<.05) than those nursing bull calves (12.39 ± .34 and 11.35 ± .33 weeks, respectively), but there was no difference (P>.05) between cows nursing heifer and bull calves at MB (8.41 ± .34 and 8.51 ± .36, respectively). In 1994 there was no difference (P>.07) in YTPL among 2, 3 and 4 year old cows (12.11 ± .43, 13.28 ± .99 and 11.99 ± .50 kgd^{-1}, respectively). In 1995 YTPL of 2-yr old cows (8.66 ± .44 kgd^{-1}) was significantly (P<.05) less than both 3 and 4-yr old cows (10.07 ± .40 and 10.62 ± .46 kgd^{-1}, respectively). As well, in 1994 YTPL was larger (P=.05) in 3 compared to 4-yr old cows while in 1995 YTPL was similar (P=.37). Reports of LOC-SEX and YR-CAGE interactions were not found in the literature.

Cow age and sex of calf effects. Cow age and sex of calf effects are listed in Table 2. Two year old cows had larger (P<.05) a values than either 3- or 4-yr old cows. Two year old cows had larger (P<.05) k values than 3-yr old cows as did 3- compared to 4-yr old cows (P<.10). Two year old cows had lower YTPL than 3-yr old (P<.05) and 4-yr old cows (P<.10). Two year old cows had lower TY than 3- and 4-yr old cows (P<.05) but there was no difference between 3- and 4-yr old cows (P>.10). These results do not support those of Jenkins and Ferrell (1992) and Hohenboken *et al. (1992)* where age of cow effects on lactation curve characteristics or total yield were not found in purebred and crossbred beef cows. These results do support the those of: Mondragon *et al.* (1983) who reported increased milk yields from first to second parity cows but little difference between second and third parities; Mallinckrodt *et al.* (1993) who reported variable but positive effects of age of cow between Polled Hereford and Simmental breeds; and McKay *et al.* (1994) who reported a positive relationship of cow age with milk weights taken in spring, August and fall at both BR and MB. Cows nursing bull calves had smaller a values (P<.05) and reached TPL earlier (P<.10) than cows nursing heifer calves. Literature reports of sex of calf effects on lactation curve characteristics and yield were not found.

Table 2. Cow age and sex of calf effects on lactation characteristics and 205-d yield[A,B]

Item		a	k	TPL (weeks)	YTPL (kg/d)	TY (kg)
Cow age (years)	2-3	.078*	.003	-.13	-1.39*	-242.4*
	2-4	.057*	.012*	-.68	-.87**	-276.9*
	3-4	-.021	.008**	-.56	.42	-34.5
Sex	M-F	-.052*	.004	-.62**	.28	35.4

[A]Lactation curve parameters are a and k which are scale and shape parameters, time of peak lactation (TPL), yield at time of peak lactation (YTPL) and 205-d total yield (TY).
[B]Standard errors range from .019 to .023 for a, from .004 to .005 for k, from .34 to .43 for TPL, from .37 to .46 for YTPL and from 45.3 to 57.2 for TY.
*,**Significantly different from zero at (P<.05) and (P<.10), respectively.

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