CRC "Regional Combinations" Project - Regional beef systems to improve productivity and profitability

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Introduction

A component of the second term of the Cooperative Research Centre (CRC) for Cattle and Beef Quality (1999 – 2005) was the development of an integrated research program (Regional Combinations project) across a range of southern Australian environments to quantify the effects on production and carcase quality of varying nutritional treatments on animals of specific genetic potential.

The study was designed to determine the most appropriate growth pathways for progeny of sires that differ in genetic potential for carcase and/or growth traits, to increase product value and herd productivity across southern Australia. The research was conducted at six locations, across 4 states, and included a variety of market specifications and production systems. The biological results and economic analyses will enable producers throughout regional Southern Australia to make confident decisions in choosing the most profitable "genetic and growth path" combinations to suit their enterprise.

Experimental progeny were generated on commercial properties and research stations in south-western New South Wales (Darlington Point), Victoria (Hamilton), South Australia (Naracoorte) and the south-west of Western Australia (Wagerup, Pinjarra and Vasse) with the first matings occurring in June 1999. The final evaluation of progeny and data analyses are planned to be completed during 2006.

The overall aims and detailed experimental design (McKiernan et al. 2005) indicate the many production, carcase, meat quality and economic issues that will be investigated in detail. Effects will be examined both within and across sites and will be reported in a series of papers. This paper highlights some interim findings from each site covering issues of meat quality, sire and dam effects and time of calving, as precursors to the final reports.

Project design

A complete description of the experimental design, methods and measurements was reported by McKiernan et al. (2005). Following is a brief synopsis of the project details:

Sires were chosen to create genetically diverse experimental progeny for the carcase traits intramuscular fat (IMF%) and retail beef yield (RBY%). They were chosen on Estimated Breeding Value (EBV) data where available, otherwise on performance expected as a characteristic (carcase type) of the breed from which they were drawn. The sires types chosen were:-

I. High RBY % types – drawn from Charolais, Limousin and Belgian Blue breeds and from Angus chosen on the basis of high EBVs for RBY%.

II. High IMF % types – drawn from the Black Wagyu breed and from Angus chosen on the basis of high EBVs for IMF%.

III. Types high for both RBY % and IMF % – drawn from Angus chosen on the basis of high EBVs and from the Red Wagyu breed.

Each sire type, but not all breeds or sires, were represented by progeny at all sites. Many of the sires used were common across sites thus establishing the genetic links required for combined analysis of effects, and in particular to allow examination of genotype by environment interactions.

To represent typical production systems in most areas of southern Australia three broad post weaning growth paths were established to test the ability of the progeny to meet market specifications. One growth path was used in SA, 2 in NSW and Vic, and 3 in WA:-

I. High growth path to achieve 0.7 – 1 kg per day from weaning to the start of a feedlot or pasture finishing phase.
II. Moderate growth path aimed at achieving approximately 0.5 – 0.6 kg per day from weaning to feedlot entry or pasture finishing phase.
III. Weight loss immediately post weaning followed by a period of rapid compensatory growth on pasture to finishing weight (WA only).

The profitability of beef production systems is affected by numerous factors such as management constraints, costs of production and product value, with genetic potential setting upper limits. A major driver (through impact on product value) should be compliance to specifications of the target market(s). Thus, defining treatment effects on an animal's ability to meet these is a vital component of this project in examining herd profitability. Each site had a similar, yet slightly different target market particular to the region or production system it represented.

The effect of time of calving on management and costs of production (and thus herd profitability) was identified as a variable that could be incorporated into the design (and analysis) of both the WA and Victorian experiments. Matings were timed for calves to be born as per current industry practice (autumn in WA and Victoria) or synchronising calving with pasture growth (winter/spring in WA and spring in Vic).

Interim results within sites

New South Wales

To improve economic returns, increased output must not compromise meat quality, since acceptance by the customers (intermediate and end consumers) is vital to maintaining carcase value in the long term. In the shorter term, since Meat Standards Australia (MSA) grading at the retail level is yet to be widely adopted, few premiums are currently paid and the emphasis is to ensure at least acceptable quality is maintained when output is increased. Preliminary analyses of the NSW data indicate more beef is produced from the higher yielding carcase types but this section will be confined to the meat quality issues.

Methods

The treatments and methods used at this site were as described in the general methods paper of McKiernan et al. (2005). At this site the sires used (total 42) to represent the 3 carcase categories defined above were drawn from Angus, Charolais, Limousin and Wagyu (Red and Black) breeds – all mated by AI to Hereford dams from a single herd. Steer progeny were grown at either conventional (approximately 0.5 kg/d) or accelerated rates (approximately 0.7 kg/d) from weaning to group mean feedlot entry weight of approximately 400 kg. All animals had identical treatment during a 100 day commercial feedlot finishing phase prior to slaughter.

Comprehensive carcase data (AUS-MEAT 1996), were collected at the abattoir and samples from the striploin (M. longissimus lumborum) were taken for analysis (McKiernan et al. 2005). Sensory data from consumer tastings (Polkinghorne et al. 1999) will be reported later, when all results are available. Samples were assayed in the laboratory for intramuscular fat (IMF %) as well as for the "objective" measurements of shear force and compression (Perry et al. 2001a). MSA feedback data were also examined for treatment effects on the predicted meat eating quality as generated by

Table 1. Effects of carcase type of the sire and of growth treatments on meat quality traits in steer progeny – predicted means for various laboratory measured and chiller assessed carcase and meat traits.

	Sire carcase type								Growth[2]	
	High RBY%			High IMF%		High RBY%/IMF%			S	F
Sire source[1]	1	4	5	2	6	3	7			
Number of progeny	106	48	54	101	64	103	63			
Trait								*s.e.d*[3]		
Shear force (N)[4]	38.8	40.6	42.7	38.3	37.9	39.9	42.5		39.8	39.9
(rank)	*(3)*	*(5)*	*(7)*	*(2)*	*(1)*	*(4)*	*(6)*	*ns*		*ns*
Compression (N)	15.9	16.5	16.6	15.6	15.2	15.7	16.8		16.2	15.8
(rank)	*(4)*	*(5)*	*(6)*	*(2)*	*(1)*	*(3)*	*(7)*	*ns*		*ns*
IMF (%)	3.67	2.96	3.20	4.49	4.75	4.24	4.15	*0.33*	3.75	4.17
(rank)	*(5)*	*(7)*	*(6)*	*(2)*	*(1)*	*(3)*	*(4)*	**/ns*		*
USmarble score[5]	351	320	306	375	381	375	355	*14*	357	356
(rank)	*(5)*	*(6)*	*(7)*	*(2)*	*(1)*	*(3)*	*(4)*	*		*ns*
AUSmarble score	1.43	1.16	0.98	1.62	1.65	1.60	1.40	*0.13*	1.45	1.45
(rank)	*(4)*	*(6)*	*(7)*	*(2)*	*(1)*	*(3)*	*(5)*	*		*ns*
Strip. PEQ (%)[6]	57.9	57.4	56.7	58.6	58.5	58.5	57.4	*0.4*	58.0	58.0
(rank)	*(4)*	*(5)*	*(7)*	*(1)*	*(2)*	*(3)*	*(6)*	*		*ns*

[1] Sire types chosen for high retail beef yield (RBY%) sourced from Angus (1), Charolais (4) and Limousin (5); for high intramuscular fat (IMF%) from Angus (2) and Black Wagyu (6); for both traits (RBY%/IMF%) from Angus (3) and Red Wagyu (7).
[2] Effects of slow (S) or fast (F) growth treatment (weaning to feedlot entry).
[3] (mean) *s.e.d.* shown for traits with significant effects of sire carcase type.
[4] Shear force and compression expressed as Newtons (= kg force x 9.81).
[5] MSA chiller assessment data for US and AUS-MEAT marble scores.
[6] Predicted eating quality (PEQ) for the striploin cut (MSA - STRO45aGRL) - data from MSA model, given as sensory scores (%), equivalent to palatability scores (CMQ4) generated by taste panel assessment.
* Significant effects of growth treatment or sire type (P<0.05); */ns, (P<0.05) for sire type at the carcase type level but not sire source.

the MSA model (Thompson 2002).

The data were analysed using a linear mixed model procedure (ASREML, Gilmour et al. 2002), examining fixed effects of growth treatment and sire carcase type (adjusted for age at start of treatment) and all random effects, including sires within type, dam, calving, feedlot/ kill cohort, chiller grader and laboratory run. Hot standard carcase weight was used as a covariate for IMF%, AUS-MEAT and US marble scores. All interactions were tested with none being significant.

Table 2. Effects of sire carcase type on eating quality predicted from the MSA model, showing the proportions of animals in relation to MSA "Star" ratings2, and on shear force values - raw data (unadjusted means) relate to the striploin cut, as described above.

	Sire carcase type						
	High RBY%			High IMF%		High RBY%/IMF%	
Sire source[1]	1	4	5	2	6	3	7
Predicted eating quality[2]							
Less than 3 Star *(n)*	*(1)*		*(1)*				*(1)*
Mean value	43.1		46.2				46.3
Within 3 Star *(n)*	*(104)*	*(48)*	*(53)*	*(101)*	*(64)*	*(102)*	*(61)*
Mean value	57.6	57.4	56.5	58.5	58.1	58.2	57.4
Greater than 3 Star *(n)*	*(1)*					*(1)*	*(1)*
Mean value	64.8					65.0	64.3
Shear force							
% above 45 Newtons[3]	19	20	35	20	23	23	30

[1] Sires chosen for high retail beef yield (RBY%) sourced from Angus (1), Charolais (4) and Limousin (5); for high intramuscular fat (IMF%) from Angus (2) and Black Wagyu (6); for both traits (RBY%/IMF%) from Angus (3) and Red Wagyu (7).

[2] MSA Star ratings – values below 48 (%) are ungraded, between 48 and 64 given 3 Star rating, those above 64 given 4 or above 80 given 5 Star rating.

[3] Shear force values above 45 Newtons may be approaching unacceptable tenderness (J.M. Thompson, *pers. comm.* 2006).

Results and discussion

Table 1. Effects of carcase type of the sire and of growth treatments on meat quality traits in steer progeny – predicted means for various laboratory measured and chiller assessed carcase and meat traits.

It can be seen from Table 1 that :-

- IMF% was the only trait significantly affected by growth rate, being higher in the fast compared to the slow growth treatments.
- There were significant differences between genotypes in several traits.
- The higher IMF% genotypes ranked first or second in all traits.
- Higher yield types consistently ranked lowest in these meat quality traits
- There was close association in the ranking of shear force and compression values
- Ranking of both shear force and compression was closely associated with IMF%

Laboratory measurements related to tenderness are useful predictors of meat eating quality, as discussed by Perry et al. (2001b), and this was apparent in the data reported here. Despite the consistently lower rankings of the progeny of higher yielding carcase types in the traits examined, almost all animals in all groups had acceptable predicted eating quality (Table 2).

Table 2 shows that most samples would be given "3 Star" rating on predicted eating quality, with only 3 animals above and 3 below that category. Tables 1 and 2 both demonstrate the association between higher predicted eating quality and genetic potential for greater fat deposition. This is consistent with the assessed (marble score) or measured (IMF%) intramuscular fat data (Table 1) and reflects the contribution of marbling to the predictions from the MSA model. However the proportions of samples with shear force values above 45 Newtons (Table 2) suggests possible lower eating quality than predicted by the model in some cases. This will be compared with sensory data when available.

These results provide good evidence that high yielding genotypes can produce meat of acceptable eating quality, although lower than that from genotypes with higher potential for fat deposition. The compromise needs to be evaluated economically and to account for actual consumer tasting results when available. The profitability of progeny of different carcase types in future markets may also be different as specifications are expected to have greater emphasis on meat quality traits.

Although statistically significant, the variation due to sire type in the predicted eating quality of the striploin (PEQ score) was not large. The contribution of growth rate in the MSA model (estimated by ossification and carcase weight) to PEQ is small (Thompson 2002) and thus it was not unexpected that an effect of growth rate was not found here. Additionally, the changes in ossification may not be very sensitive to actual age in the range covered by these animals - mean 19.8 (range 16-22) months for the faster and 25.1 (22-28) for the slower growth groups. Perry and Thompson (Perry 2003; Perry and Thompson 2005) found that palatability of grilled striploins was generally improved in animals grown faster during finishing and sometimes in those grown faster during backgrounding. However this was not always reflected by changes in shear force. These authors concluded that effects were often confounded with age at slaughter, suggesting

Table 3. Effects of breed of sire and dam on hot standard carcase weight (kg) in the progeny (predicted means across steers and heifers). Numbers of progeny within sire X dam cells averaged 14.

Dams / Sires	High IMF%[1]	High IMF% and RBY%[1]	High RBY%[1]	Lim.[2]	Wag.[2]	*Overall* (s.e.d. 6.4)[3]	*(n)*
Angus	288	288	292	306	265	*288*	*(176)*
Angus X Hereford	310	296	303	295	280	*297*	*(50)*
Hereford X Angus	293	287	306	303	259	*290*	*(48)*
Hereford	289	295	287	287	256	*283*	*(171)*
Limousin X Angus	298	317	290	289	263	*291*	*(51)*
Limousin X Hereford	285	290	311	334	247	*293*	*(31)*
Simmental X Angus	297	331	296	313	277	*303*	*(34)*
Simmental X Hereford	296	303	309	292	276	*295*	*(16)*
Overall (s.e.d. 5.8)[3]	*294*	*301*	*299*	*302*	*265*		
(n)	*(154)*	*(78)*	*(142)*	*(98)*	*(105)*		*(577)*

[1]All Angus sires in these categories; [2]Limousin and Black Wagyu sires.
[3]s.e.d. appropriate to comparisons within column or row for overall means (P<0.05).

an explanation for previous equivocal results. Final conclusions from this study must await examination of sensory data when available.

Concluding messages

While the predicted eating quality data (from the MSA model) showed some significant differences, they were not large, and firm conclusions on the effects of genotype and growth path treatments must await the analysis of all sensory eating test data. The results presented here are consistent with the contribution of intramuscular fat, either assessed by marble score or measured in the laboratory, to the generation of predicted eating quality in the MSA model; treatments or genotypes that increase intra muscular fat should improve palatability in practice.

Greater output of beef from high yielding carcase types is likely to be accompanied by some decline in both predicted and measured meat quality traits. The economic consequences of this trade-off will be fully examined later, but it is unlikely to negate the value of increased total output until discounts/ premiums for quality traits are increased from the current levels.

Victoria

Methods

At Hamilton mature autumn and spring calving straight-bred and crossbred cows were joined (by AI) to sires of varying carcase types. A total of 39 sires, as detailed in the general methods described by McKiernan et al. (2005), were chosen to represent the carcase types described above, using EBVs where available or as indicated by breed type - High RBY% drawn from Angus and Limousin; High IMF% drawn from Angus and Black Wagyu; high for both traits (High IMF% and RBY%) drawn from Angus. The cows used were derived from a multi-breed project (Graham et al. 2000), by mating Angus and Hereford cows to Angus, Hereford, Limousin or Simmental sires, resulting in eight different genotypes in the dams of the progeny examined here.

Carcase data were collected at slaughter of the progeny as described in McKiernan et al. (2005). Data were analysed by the Genstat REML procedure (Genstat 2005), with fixed effects of sire-type, growth path, sex, slaughter date, breed of dam, calving season and random effect of sires within type; non-significant terms were dropped from the model. Hot standard carcase weight was used as a covariate for these carcase measurements. Interactions between sire-type, cow sire breed, cow dam breed and growth path were tested, and were not significant for any trait. Here we report differences in carcase traits in the progeny due to breed of dam and carcase type of the sire.

Results and discussion

Hot standard carcase weight: The significant difference between sire-types is due to the lower weight of the Wagyu sired progeny; there was little difference between the Angus selected for High IMF% or High RBY%. The carcases of the progeny from the straight-bred Angus and Hereford cows were generally lighter than those of the crossbred cattle (Table 3).

Marbling Progeny of Angus bulls chosen for higher IMF% generally had the highest marble scores, followed by Wagyu progeny with Limousin progeny generally always lowest. Breed of dam also influenced marble score, with the Limousin-cross cows having progeny with generally lower scores (Table 4).

Table 4. Effects of breed of sire and dam on average MSA marble score in the progeny (predicted means across steers and heifers). Numbers of progeny within sire X dam cells averaged 14.

Dams / Sires	High IMF%[1]	High IMF% and RBY%[1]	High RBY%[1]	Lim.[2]	Wag.[2]	*Overall* (s.e.d. 0.124)[3]	*(n)*
Angus	1.80	1.84	1.58	1.12	1.68	*1.60*	*(176)*
Angus X Hereford	1.65	1.80	1.56	1.31	1.72	*1.61*	*(50)*
Hereford X Angus	1.95	1.82	1.73	0.96	1.77	*1.64*	*(48)*
Hereford	1.67	1.63	1.39	1.05	1.72	*1.49*	*(171)*
Limousin X Angus	1.46	1.18	1.48	0.93	1.44	*1.30*	*(50)*
Limousin X Hereford	1.70	1.54	1.45	0.45	1.53	*1.33*	*(31)*
Simmental X Angus	1.91	1.92	1.29	0.93	1.57	*1.53*	*(34)*
Simmental X Hereford	1.67	1.31	1.25	1.41	1.91	*1.51*	*(16)*
Overall (s.e.d. 0.126)[3]	*1.73*	*1.63*	*1.47*	*1.02*	*1.67*		
(n)	*(154)*	*(77)*	*(142)*	*(98)*	*(105)*		*(576)*

[1]All Angus sires in these categories; [2]Limousin and Black Wagyu sires.
[3]s.e.d. appropriate to comparisons within column or row for overall means (P<0.05).

Carcase yield – RBY% The progeny of sire-types selected for High RBY% had higher yielding carcasses. The European cross cows (Limousin and Simmental cross) had higher yielding progeny, particularly the Limousin cross Hereford (Table 5).

Table 5. Effects of breed of sire and dam on VIAScan carcase yield % in the progeny (predicted means across steers and heifers). Numbers of progeny within sire X dam cells averaged 12.

Dams \ Sires	High IMF%[1]	High IMF% and RBY%[1]	High RBY%[1]	Lim.[2]	Wag.[2]	*Overall* (s.e.d. 0.36)[3]	*(n)*
Angus	67.1	67.8	68.3	68.9	67.3	*67.9*	*(132)*
Angus X Hereford	67.1	67.9	68.2	69.2	66.9	*67.9*	*(40)*
Hereford X Angus	67.1	68.0	68.2	69.3	68.1	*68.1*	*(36)*
Hereford	67.1	67.5	68.0	69.7	67.2	*67.9*	*(129)*
Limousin X Angus	67.8	67.4	67.7	70.0	68.6	*68.3*	*(43)*
Limousin X Hereford	68.0	68.9	68.5	71.6	68.9	*69.2*	*(23)*
Simmental X Angus	68.4	69.2	68.3	70.1	68.2	*68.8*	*(26)*
Simmental X Hereford	67.5	70.2	70.2	67.6	67.8	*68.7*	*(13)*
Overall (s.e.d. 0.33)[3]	*67.5*	*68.3*	*68.4*	*69.5*	*67.9*		
(n)	*(123)*	*(60)*	*(106)*	*(69)*	*(84)*		*(472)*

[1]All Angus sires in these categories; [2]Limousin and Black Wagyu sires.
[3]s.e.d. appropriate to comparisons within column or row for overall means (P<0.05).

Both breed of dam and sire carcase type influenced all carcase parameters (Tables 3, 4 and 5), however there were no significant sire-type by breed of dam interactions with any carcase parameters. The fact that there was no dambreed by sire-type interaction indicates that Breedplan selected bulls will produce a similar outcome in terms of the selected trait, irrespective of dam breed.

Concluding messages

The genotype of the dam, although EBVs are rarely available, may contribute considerably to carcases in the progeny, as shown here and supported by the results from SA (below). The relative contributions of the sire and dam genotype needs careful consideration. While changing sire genotype is comparatively easy to implement, changing the genetic composition of the dams is a much slower and/or potentially more expensive operation, with long lasting implications for the production system.

These and other data from the Regional Combinations project could form the basis for further work in the prediction of progeny phenotype based on sire type, dam type, growth path and market destination.

South Australia

Methods

At Struan Research Centre a range of female genotypes were mated by AI to bulls (total 35) representing the carcase types described above, and as detailed in the general methods described by McKiernan et al. (2005). High RBY%, High IMF% and High for both RBY% and IMF% sire types were drawn from Angus, Limousin and Wagyu breeds as for the Victorian site (above). Dams were drawn from a variety of sources, including the multi-breed project (Graham et al. 2000). No nutritional treatments were applied at this site but effects of year and season were apparent. Collection and analysis of data for this site were also as described for the Victorian site.

Results and discussion

Sire carcase type had significant effects on all carcase traits in the progeny - the combined effect resulting in significant differences in carcase value (Table 6).

There were significant effects of the sire of the dam on both EMA and P8 fat in the progeny (Table 7). Simmental cross cows produced calves with greater EMA than the Angus, Hereford or Limousin cross cows. Calves of Simmental cross cows also had the lowest P8 fat mean, but the data suggested higher carcase value.

Concluding messages

These preliminary data suggest additional effects of breed of dam (as well as that of the sire) on carcase traits, and consequently on commercial value in the progeny.

The results from SA and Victoria, as well as those above from NSW, clearly demonstrate the effect of using sires selected on EBVs on progeny performance. Selecting sires based on EBVs for carcase traits (which themselves are an "estimated" value) resulted in the "expected" or "predicted" response in the carcases of their calves.

Table 6. Effect of sire carcase type on carcase weight (HSCW), eye muscle area (EMA), fatness (P8) and value of carcases (Value$) in the progeny (predicted means for carcase traits across steers and heifers).

Sire Carcase type	*(n)*	HSCW (kg)	EMA (cm²)	P8 (mm)	Value[1] ($)
High IMF%	*(105)*	262	66.9	16.1	789
High IMF%/RBY%	*(48)*	267	68.9	15.2	821
High RBY%	*(89)*	269	67.9	13.7	827
Limousin	*(43)*	270	72.7	11.6	821
Wagyu	*(30)*	251	66.3	16.8	738
s.e.d.[2]		*4.9*	*1.35*	*0.97*	*24.2*

[1]Value$ is based on actual price paid for carcases for each group.
[2]s.e.d. shown for traits with significant differences within columns (P<0.05).

Table 7. Effect of the breed of the sire of the dam on carcase weight (HSCW), eye muscle area (EMA), fatness (P8) and value of carcase (Value$) in the progeny (predicted means for carcase traits across steers and heifers).

Breed of sire of dam	(n)	HSCW (kg)	EMA (cm^2)	P8 (mm)	Value[1] ($)
Angus	*(116)*	262	67.9	14.5	789
Hereford	*(109)*	260	67.3	15.8	784
Limousin	*(45)*	264	68.3	15.3	791
Simmental	*(55)*	269	70.7	13.1	833
s.e.d.[2]		*n.s.*	*1.17*	*0.86*	*n.s.(P~0.1)*

[1]Value$ is based on actual price paid for carcases for each group.
[2]s.e.d. shown for traits with significant differences within columns (P<0.05).

Western Australia

Economic benefits from matching calving with pasture growth

In the Mediterranean environment of the south-west of Western Australia the traditional calving time is late summer and autumn. At this time, pasture quality and quantity are generally poor and large amounts of supplementary hay are required to prevent excessive weight loss in the cows, thus imposing a major cost on the beef production enterprise. By synchronizing calving with pasture growth there should be both a reduction in quantity of supplements fed and cost savings. Combining calving time with selection of sire type should satisfy market specifications and have a major effect on herd profitability in this region. Some details of this study were discussed in a previous paper by Tudor et al. (2004).

Methods

Here the economics of synchronising calving with pasture growth (Winter/Spring) are compared with the traditional autumn calving system. The data were derived from 3 years experimentation at the ALCOA Farmlands site and Figure 1. shows the relationship between annual pasture energy supply (MJ ME supply per ha per day) and the estimated nutritional requirements of the cow and the calf for autumn and winter calving times. The area between the lines and pasture energy supply is the gap that has to be filled with supplementary hay which averaged 629 and 133 kg/cow, for autumn and winter calving respectively.

Economic analysis

The pasture energy supply and cow/calf demand were used to build an economic model to compare the two calving times. Information for the model included:

- Property of 1,170 ha with stocking rate of 9.1 DSE/ha with all supplementary feed grown on the property. This is the average size of properties in the south-west of WA.
- Autumn calving cows fed 5 kg/day pasture hay for 150 days and winter cows 2kg/day for 90 days. Autumn calving cows fed 629 kg/hd compared with 133 kg/hd for Winter calving cows.
- Hay costed @ $100 per tonne.
- Reduction in demand for supplementary feed in winter calving system increases the available area for grazing and the number of cattle to maintain an equivalent stocking rate.
- Autumn calves were approximately 80 kg heavier than the Winter calves when weaned in January. Average weight of Autumn and Winter weaners were 354 and 274 kg, respectively.
- Scenarios 1 (Autumn calving) and 2 (Winter calving) in Table 8 are the experimental treatments. In Scenario 3 (Winter calving with increased stocking rate) it was assumed all parameters remain constant except stocking rate was increased by approximately 10% (to 10.0 DSE per hectare) to reflect the extra feed available.
- Heifer and steer calves are sold for 160 and 165 c/kg live weight respectively. (There is some basis for the lighter, younger winter calves receiving a price premium - however this has not been assumed in this analysis.)

Results and discussion

Results from the economic model indicate that changing calving from autumn to winter at an equivalent stocking rate increased the operating profit of the enterprise by approximately 5% and

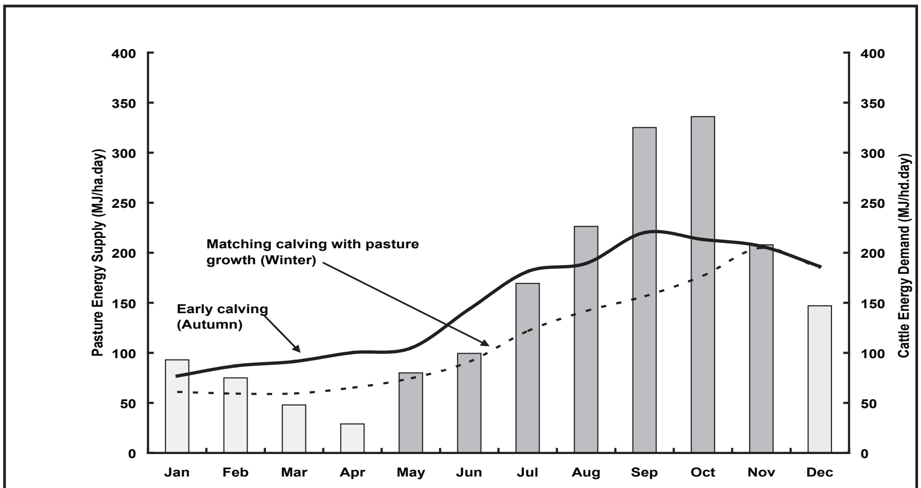

Figure 1. Pasture energy supply (MJ/ha.d) and cow/calf energy requirement (MJ/ha.d) for Early (Autumn) and Late (Winter) calving.

Table 8. Economic performance indicators associated with autumn and winter calving

	Scenarios		
Key Performance Indicators	1 Autumn Calving	2 Winter Calving	3 Winter Calving + 10% Stocking Rate
Enterprise Operating Profit	$90,341	$94,795	$131,197
Operating Profit per Hectare	$ 77.00	$81.00	$112
Herd Cost per Head*	$121.26	$60.45	$60.45
Kg beef sold per Hectare	280	254	279
Cost of Production per kg Sold	$ 1.28	$1.21	$1.13

* Those variable costs directly related to the herd:- e.g. requisites, supplement & selling costs.

by approximately 45% when the stocking rate increased by 10% (Table 8). This improvement in financial performance was primarily due to a reduction in the cost of production in the Winter calving enterprises by around 5% (7 c/kg sold) in an equivalent stocking rate (Scenario 2) and 12% (15 c/kg sold) with the increased stocking rate (Scenario 3). In Scenario 2, although revenue from kgs beef sold / ha was reduced, the lower cost of production outweighed the reduction in income. Scenario 3 generated similar revenue and kgs of beef sold / ha to the autumn calving enterprise (Scenario 1) but with around a 12% reduction in cost of production making this type of enterprise more profitable than a traditional autumn calving operation.

Concluding messages

There are real economic benefits of synchronising calving with pasture growth due mainly to the reduction in amount, and therefore the cost, of supplements fed. Despite the lower weights of the weaners from the winter calving, local experience suggests they may attract a premium from lot feeders, which would add further attraction to this strategy.

General discussion

The Regional Combinations project was designed to generate data to enable decisions to be made about the most appropriate combinations of growth and genetics to increase product suitability for market and hence carcase value and herd profitability. The design incorporated various regional peculiarities that have major impacts on herd productivity across southern Australia.

The results presented here demonstrate the effects of the choice of sire and dam genotype on progeny carcase performance, including meat quality aspects. This, combined with the effects of growth path on the progeny, provides the basis for further work to be done to determine the optimisation of factors contributing to the prediction of animals meeting increasingly stringent market requirements. The effect on profitability of altering calving time was also well demonstrated. Consequently producers will be able to confidently choose the most profitable combinations of genetics, growth path and associated management strategies for their enterprise and location.

References

AUS-MEAT (1996) 'Chiller assessment standards.' (AUS-MEAT Ltd: Brisbane).

Genstat (2005) Release 8.1.0.152 for Windows, Lawes Agricultural Trust, United Kingdom.

Gilmour AR, Cullis BR, Welham SJ, Thompson R (2002) ASREML Reference Manual. NSW Agriculture Biometrics Bulletin, No 3., NSW Agriculture, Orange, NSW, Australia.

Graham JF, Clark AJ, Hayes GA, Kearney GA, Deland MPB (2000) The effect of genotype on growth and fatness when Angus, Hereford, Limousin and Simmental sires are mated to Angus and Hereford cows. Asian-Australasian Journal of Animal Sciences 13 (Supplement July 2000) C: 325-328.

McKiernan WA, Wilkins JF, Barwick SA, Tudor GD, McIntyre BL, Graham JG, Deland MPB, Davies L (2005) CRC "Regional Combinations" Project – effects of genetics and growth paths on beef production and meat quality:experimantal design, methods and measurements. Australian Journal of Experimental Agriculture 45 (7-8): 959-969.

Perry Diana (2003) Which are more tender – fast-growing or slow-growing cattle? In: Proceedings of "The Beef Products Program: Technology - our future" (JF Wilkins Ed.). Beef Products Conference. pp. 64-66. (NSW Agriculture: Orange).

Perry D, Shorthose WR, Ferguson DM, Thompson JM (2001a) Methods used in the CRC program for the determination of carcass yield and beef quality. Australian Journal of Experimental Agriculture 41, 953-957.

Perry D, Thompson JM, Hwang IH, Butchers A, Egan AF (2001b) Relationship between objective measurements and taste panel assessment of beef quality. Australian Journal of Experimental Agriculture 41, 981-989.

Perry D, Thompson JM (2005) The effect of growth rate during backgrounding and finishing on meat quality traits in beef cattle. Journal of Animal Science 69, 691-702.

Polkinghorne R, Watson R, Porter M, Gee A, Scott J, Thompson J (1999) Meat Standards Australia, a 'PACCP' based beef grading scheme for consumers. (1) The use of consumer scores to set grade standards. In: Proceedings of the 45th International Congress of Meat Science and Technology 45, 14-15.

Thompson John (2002) Managing meat tenderness. Meat Science 62, 295-308.

Tudor GD, Della Bosca TJ, McIntyre BL, Read D, Smart WL, Taylor EG, Hiscock AJF (2004) Optimising feed supply, reproductive efficiency and progeny growth to meet market specifications. 1. Background and experimental design. Animal Production in Australia 25, 334.

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