

Economics of alternative growth path, time of calving and breed type combinations across southern Australian beef cattle environments: grass finishing at the Victorian experimental site

J.G. Graham[1], H. Quinn[2], B.L. Davies[3] and G.R. Griffith[4]

Cooperative Research Centre for Beef Genetic Technologies, University of New England, Armidale NSW 2351, and [1]Department of Primary Industries Victoria, Hamilton VIC 3300
[2]Department of Primary Industries Victoria, Box Hill VIC 3128
[3]Industry and Investment NSW, Paterson NSW 2421
[4]Industry and Investment NSW, Armidale NSW 2351
garry.griffith@industry.nsw.gov.au

Abstract. The Beef CRC "Regional Combinations" project and its biophysical outcomes have been described in a range of journal articles and project reports. In this project, different combinations of beef cattle genetics, growth/nutritional pathways and calving seasons were examined across a number of sites in southern Australia for achievement of targeted market specifications. The information provided in these papers and reports allows identification and evaluation of the most profitable regional beef cattle production systems. The focus of this paper is on the Victorian experimental site, where the cattle were finished to slaughter weight on pasture. A range of breed types was included with emphasis on high retail beef yield and high intramuscular fat. Two different growth treatments were imposed following weaning (Fast ~ 0.8 kg/day, Slow ~ 0.6 kg/day), and autumn and spring calving systems were also compared. The effects on carcase and meat quality and enterprise profitability were then examined.

Carcase weight and faster growth were the main drivers of profitability at the Victorian site. There were only small and mostly not significant differences between the various sire type groups for carcase weight, except for Wagyu progeny, which had lower slaughter and carcase weights compared with other groups. Furthermore, the results have demonstrated the effect of using BREEDPLAN EBVs for selection of the most appropriate sires to produce carcases with the best compliance to the targeted market. Selection for individual carcase traits had significant effects in one generation, and responses were quite consistent under different growth regimes. In this experiment, there was little difference in mean gross margins between autumn and spring calving.

Keywords: Beef, breed, growth path, economics, evaluation, Australia.

Background

About one-third of Australian beef production is consumed domestically (ABARE 2007), and most of the supply for this market is derived from the higher rainfall areas of southern Australia where turn-off rates and cattle values are higher than for the pastoral regions of northern Australia (ABARE 2008). Meat quality is becoming an increasingly important issue for Australian beef producers as domestic market specifications become more stringent. The development of the Meat Standards Australia (MSA) grading system has shown that domestic consumers are able to discriminate between beef of differing eating qualities (Polkinghorne et al. 2008), and are willing to pay a premium for higher quality beef (Griffith et al. 2009). In particular, intramuscular fat (IMF) has been shown to be positively correlated with improved eating quality (Egan et al. 2001) and minimum IMF percent (assessed by marble score) is now included in some high quality domestic market specifications. Premiums for IMF are now available through some over-the-hooks and contract markets. Therefore, producers now have options to produce cattle with a focus on carcase yield (retail beef yield or RBY), or on IMF, or in some cases, on both traits. However, the evidence supporting selection of an optimal growth path is not clearcut.

The "Regional Combinations" project of the Cooperative Research Centre for Cattle and Beef Quality focussed on regional beef production systems at four sites in southern Australia – southern New South Wales (NSW), western Victoria (VIC), south-east South Australia (SA) and south-west West Australia (WA). One of the objectives of the project was to examine the economics of different combinations of beef cattle genetics and growth/nutritional pathways to achieve targeted specifications across various environments in southern Australia. This paper describes a farm-level modelling system that allows an economic evaluation of the experimental results, and the economic outcomes of applying this system at the Victorian site are reported. Implications are then drawn for beef cattle producers in the study area. The distinguishing feature of the design for the Victorian site was that the cattle were finished to slaughter weight on pasture instead of in a feedlot.

At the Victorian site the breed types included were Angus selected for high RBY, Angus selected for high IMF, Angus selected for both high RBY and high IMF, Belgium Blue, Limousin (both high RBY), and Black Wagyu (high IMF). Two different growth treatments were imposed following weaning (Fast ~ 0.8 kg/day, Slow ~ 0.6 kg/day). The effects on carcase and meat quality were then examined. Data were analysed to examine the effects of growth treatment post weaning and sire carcase type. The effects of calving seasons were also analysed.

The overall design and methodology of the Regional Combinations project was described by McKiernan et al. (2005), while most of the results have been reported in McKiernan et al. (2007). The broad economic implications have been reported in Davies et al. (2009), while the results for the NSW site focussing on feedlot finishing have been reported in Davies, Alford and Griffith (2009).

Method

As with a previous analysis of cattle experimental work at the Grafton Advisory and Research Station (Alford et al. 2007), experimental protocols were imposed in this project to allow the results to be statistically analysed in relation to the objectives and hypotheses tested. However, these protocols resulted in several decisions being made that would not be consistent with normal commercial practice. The very poor seasonal conditions during much of the experimental phase necessitated the use of large levels of supplementation of some cow treatment groups to obtain the targeted high nutritional planes across most sites. These levels and consequent costs of feed supplements would be uneconomic in commercial beef production terms. Also, slaughter was based on age rather than a target weight at most sites.

Therefore, it was decided not to model the experimental data exactly as recorded, but to examine the implications of the experimental outcomes for a commercial producer by incorporating the key results into regionally-representative cattle enterprise models. The limitations of this approach to extrapolating trial data to farm-level analyses can be addressed to some extent through the appropriate validation of the model used and the use of sensitivity analyses of key assumptions (Dillon and Anderson 1990). See also the discussion in Davidson and Martin (1965) on this topic.

A farm-level economic evaluation of the experimental outcomes was undertaken, using the Beef-N-Omics software package (Dobos et al. 1997, 2006). This package is designed to analyse the effects that different management practices have on the profitability of a beef herd. The program integrates herd structures, feed budgets and financial gross margin budgets for beef cattle breeding herds. The package calculates gross margin per cow, per $100 capital, per hectare and per tonne dry matter (DM), as well as the monthly feed surplus or deficit.

Adjustments to herd size, monthly pasture growth, months of calving, age and weight of turn-off, market prices, seasonal pasture growth, variable costs, cow size, weaning percentage, or other aspects of herd management can be made to assess their impact on feed requirements and subsequently on herd gross margins. Adjustments to any of these parameters will be reflected in changes in monthly feed consumption and herd gross margin.

Beef-N-Omics is a static herd model designed so that all the inputs are used in the calculations. This assumes that these inputs have been the same for the entire history of the herd being analysed. Because of this, Beef-N-Omics cannot accurately assess the outcome of changes to sales policy, breeding or culling policy or calving patterns, which will only be applied for a year or two, for example, during droughts.

Further, Beef-N-Omics is not a full biological model. Local estimates can be used, but if accurate information is available, then more precise reports are generated. A disadvantage with this approach is that users must remember to input all the correlated consequences of any change to major inputs. A misleading output could result if this is not the case. Examples are provided in the User's Manual (Dobos et al. 2006).

The general approach to modelling was as follows. First, the production system modelled was chosen to be representative of the region hosting the experimental site. Second, to reduce the complexity of the economic analysis, it was assumed that the same land resource and the same associated pasture resource would apply for each of the growth treatments. Energy available for the herd was varied by altering the stocking rate to provide just enough metabolisable energy (ME) to meet the relevant sets of cattle growth rates. For the Victorian site, stocking rate was determined by adjusting breeding cow numbers until the total feed deficit was 200 kg DM/ha, suggested as commercial practice by local research and advisory staff. Thus, 100 breeding cows could be run on the assumed 200 ha of available pasture for the Slow, Autumn calving all breeds scenario, but 118 breeding cows could be run for the Fast, Autumn calving all breeds scenario (see Table 1). The limitations of this approach are recognised given the simple ME approach used by Beef-N-Omics and the associated pasture modelling, however, the methodology allows for a consistent approach across all experimental treatments.

Third, for each treatment analysed, actual group mean slaughter weights are entered from the experimental data. Fourth, given a set of prices and costs, gross margins are calculated for the treatment being analysed.

The specific input assumptions made for the Victorian analyses are given in the Appendix. The pasture data (for Hamilton) is given in Table 4, and the herd parameters, costs and returns in Table 5. The actual price grid used is shown in Table 6. Prices and costs used in the analysis are for 2006. Herd costs and returns for the cow-calf activity representative of the Hamilton district of Victoria are derived from a standard Department of Primary Industries Victoria budget (see Davies et al. 2009 for greater detail).

Results

All calves were weaned at a common weight and the weaners were grown to approximately 550 kg and slaughtered. Although the growth treatments chosen were not extreme in terms of weight gain per day achieved, they resulted in a mean difference of 5.7 months in age at slaughter: the Fast growth path averaged 22.2 months at slaughter, and the Slow growth path averaged 27.9 months. There was a mean difference of 12 kg in slaughter liveweight favouring the Slow growth paths, but no difference in carcase weight (HSCW), because of a compensating effect of a higher dressing percentage in the Fast growth path groups.

The proportions of carcases meeting the relevant price grid (Table 6) were examined to assess compliance. The percentages of carcases meeting both major criteria in the specification (HSCW and rump fat (P8)) were low in all groups. The Wagyu-sired progeny had the lowest compliance, due to the majority of carcases failing to meet the weight specification. Although differences were small, there was a trend for the Angus sire types selected for higher RBY to have more progeny meeting market specifications than those selected for high IMF. Compliance was dependent mainly on variation in liveweight and fat. Since there is no consideration of carcase yield in the grid, there was no advantage in payment for higher yielding animals, and this will remain the case until changed by the processors. Penalties due to poor compliance are compounded by low carcase weight.

Tables 1, 2 and 3 compare gross margins per cow and per hectare for the various combinations of growth treatment and season of calving. These results demonstrated the importance of finishing cattle on a Fast growth path to enable faster turnover. This ensures that the period of higher stocking rate when slaughter cattle are being run on the property is as short as possible. The Wagyu progeny had a large effect on the outcomes of these analyses because of their much lower slaughter and carcase weights compared with other groups. Thus, scenarios were examined both with and without these animals included.

Table 1 shows that while the highest gross margin/cow ($717) was achieved with a Slow growth group (spring calving, Wagyu excluded), the highest gross margin per hectare ($412) was achieved using a Fast growth path post weaning (autumn calving, Wagyu excluded). The Beef-N-Omics analyses demonstrated the importance of producing cattle with heavier slaughter weights, highlighted when comparing the best outcome ($412/ha, Wagyu excluded), with the same scenario for Wagyu progeny only ($376/ha). Apart from the Wagyu progeny, there were only small and mostly not significant differences between the various sire type groups for carcase weight, so the gross margin results for separate sire type groups will not be presented.

There was little difference in mean gross margins between autumn and spring calving (Tables 2 and 3), however, comparing the average gross margins for calving season and growth path, it can be seen that for the earlier finishing, Fast growth path system, autumn calving gave the highest gross margins per hectare ($396), and for the Slow finishing system, spring calving gave the highest gross margin ($354). This would most likely be due to the autumn calving system with earlier finishing cattle being better matched to feed supply, compared with a spring calving system.

Thus the effects of carcase weight and faster growth have emerged as the main drivers of profitability. Further, the results have demonstrated the effect of using BREEDPLAN

EBVs for selection of the most appropriate sires to produce carcases with the best compliance to the targeted market.

Conclusions

The Regional Combinations project was designed to build on the nutritional and genetic principles affecting the quality of beef production studied in previous research programs by focussing on regional beef production systems at four sites across southern Australia (McKiernan et al. 2005). The combined effects of different growth paths and genetic potential on performance and carcase traits were examined for each site over a number of years to determine the best regional combinations to meet targeted market specifications. At the Victorian site, two different growth treatments were imposed following weaning (Fast ~ 0.8 kg/day, Slow ~ 0.6 kg/day) on animals of diverse genetic potential for carcase traits (RBY and IMF). This provided the production information to evaluate the regional outcomes economically, and this was done by incorporating the key experimental results into a regionally-representative cattle enterprise model using the Beef-N-Omics software package.

The effects of carcase weight and faster growth have emerged as the main drivers of profitability in this region of western Victoria. Apart from the Wagyu progeny, there were only small and mostly not significant differences between the various sire type groups for carcase weight. However, the Wagyu progeny had a large effect on the outcomes of these analyses because of their much lower slaughter and carcase weights compared with other groups. Further, the results have demonstrated the effect of using BREEDPLAN EBVs for selection of the most appropriate sires to produce carcases with the best compliance to the targeted market. Selection for individual carcase traits had significant effects in one generation, without detriment to liveweight, and responses were quite consistent under different growth regimes. In this experiment, there was little difference in mean gross margins between autumn and spring calving.

The results indicate that regional cattle producers need to have a good understanding of their whole farm system when considering the appropriate combinations of breed type, time of calving and growth path that is best for them. For example, while there was little difference in mean gross margins between the traditional autumn and spring calving, there might be significant differences in individual farm businesses in relation to labour requirements and availability, and pasture types and growth rates through the year and consequent implications for stocking rates at different growth rates. Sale weights and prices received for both weaners and finished cattle will also vary through the year as will supplementary feed requirements, availability and price. A specialised software package like Beef-N-Omics makes consideration of all these factors formal and explicit.

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References

Australian Bureau of Agricultural and Resource Economics 2007, *Commodity Statistical Bulletin*, ABARE, Canberra.

Australian Bureau of Agricultural and Resource Economics 2008, Australian Beef 08.1, ABARE, Canberra.

Alford A, Cafe L, Greenwood P and Griffith GR 2007, 'The Economic Effects of Early-Life Nutritional Constraints in Crossbred Cattle Bred on the NSW North Coast', *Economic Research Report No. 33*, NSW Department of Primary Industries, Armidale, May. Available at: http://www.dpi.nsw.gov.au/research/areas/health-science/economics-research/reports/err33

Davidson BR and Martin BR 1965, 'The relationship between yields on farms and in experiments', *Australian Journal of Agricultural Economics,* 9(2): 129-140.

Davies L, Quinn H, Della Bosca A, Alford A and Griffith G 2009, The Economic Effects of Alternate Growth Path and Breed Type Combinations to Meet Beef Market Specifications across Southern Australia, *Economic Research Report No. 39*, NSW Department of Primary Industries, Armidale, July. Available at:

http://www.dpi.nsw.gov.au/research/areas/health-science/economics-research/reports/err39

Davies L, Alford A and Griffith G 2009, 'Economic effects of alternate growth path, time of calving and breed type combinations across southern Australian beef cattle environments: feedlot finishing at the New South Wales experimental site', *Animal Production Science* 49 (5&6), 535-541.

Dillon JL and Anderson JR 1990, *The Analysis of Response in Crop and Livestock Production*, Third Edition, Pergamon Press, Oxford.

Dobos RC, Carberry PJ, Vleeskens S, Sangsari E, Johnston B and Oddy VH 1997, 'An age and herd structure model for beef breeding enterprises', *Proceedings of the International Congress on Modelling and Simulation, Hobart, Tasmania*, 1080-1085.

Dobos R, Carberry P and Davies L 2006, *Beef-N-Omics for Windows, User's Manual*, NSW Department of Primary Industries, Orange, July.

Egan A, Ferguson DM and Thompson JM 2001, 'Consumer sensory requirements for beef and their implications for the Australian beef industry', *Australian Journal of Experimental Agriculture,* 41: 855-859.

Griffith, GR, Rodgers, HJ, Thompson, JM and Dart, C 2009, 'The aggregate economic benefits from the adoption of Meat Standards Australia', *Australasian Agribusiness Review,* 17(5): 94-114. Available at: http://www.agrifood.info/review/2009/Griffith_Rodgers_Thompson_Dart.pdf

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

McKiernan WA, Wilkins JF, Graham JF, Tudor, GD, Deland MPB, McIntyre BL, Orchard B, Walkley JRW, Davies BL, Griffith GR and Irwin J 2007, Regional Beef Systems to Meet Market Specifications, Final Report on Project SBP.006V2, Meat and Livestock Australia Limited, North Sydney, May.

Polkinghorne R, Thompson JM, Watson R, Gee A and Porter M 2008, 'Evolution of the Meat Standards Australia (MSA) beef grading system', *Australian Journal of Experimental Agriculture*, 48 (11): 1351-1359.

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Appendix

Table 1. Gross margins of various combinations of growth treatment and season of calving using common weaning weights for all sire types

Calving season	Growth path	Sire type	No cows**	GM total $	GM $/cow	GM $/ha
Autumn	Fast	No Wagyu*	117	82,472	705	412
Autumn	Fast	All	118	80,257	680	401
Autumn	Fast	Wagyu only	122	75,235	617	376
Spring	Fast	No Wagyu	104	74,382	715	372
Spring	Fast	All	106	74,084	699	370
Spring	Fast	Wagyu only	109	68,508	628	342
Autumn	Slow	No Wagyu	99	68,177	689	341
Autumn	Slow	All	100	66,439	664	332
Autumn	Slow	Wagyu only	103	61,274	595	306
Spring	Slow	No Wagyu	102	73,120	717	366
Spring	Slow	All	104	72,934	701	365
Spring	Slow	Wagyu only	105	66,228	639	331

* All sire types used excluding Wagyu
** Comparative carrying capacity generated by Beef-N-Omics for the various scenarios

Table 2. Gross margins ($/ha) for growth path and season of calving

	Growth path		
Calving season	Fast	Slow	Mean
Autumn	396	326	361
Spring	361	354	358
Mean	379	340	360

Table 3. Gross margins ($/ha) for sire type, growth path and season of calving

Sire type	Fast	Slow	Autumn	Spring	Average
All	386	349	367	368	367
No Wagyu	392	354	377	369	373
Wagyu	359	319	341	337	339
Grand Total	379	340	361	358	360

Assumptions used in the Victorian Beef-N-Omics analyses

Table 4. Victorian pasture carryover and growth rate (Hamilton)

	Feed carried over to following month (%)	Growth rate (kg DM/ha/d)
Jan	50	2
Feb	75	3
Mar	55	5
Apr	50	13
May	40	20
Jun	10	12
Jul	10	12
Aug	10	22
Sep	30	44
Oct	60	73
Nov	70	65
Dec	80	9

Month when least kg DM available = May

Table 5. Victorian herd parameters, costs and returns

Parameter	Autumn Slow	Autumn Fast	Spring Slow	Spring Fast
Age at last joining before cows culled for age	10 years			
Month when dry cows sold	Jan		May	
Proportion of dry cows sold	100%			
Month when other culls sold	Jan		May	
Proportion of other herd sold as culls	2%			
Heifers kept in herd	No			
Age at joining heifers (months)	15 months			
Replacement heifers (cows) 100% of total replacement as:	Heifers empty & dry			
Month of purchase	May		Sept	
Price	$800/cow			
Age at purchase	1 year			
Working life of bulls	4 years			
Cost of replacement bulls	$5000/bull			
Freight on sales:	$8/hd			
Freight on purchases:	$20/hd			
Yard dues and fees:	$5/hd			
Commission: sales	4%			
Transaction levy:	$3.5/hd			
Health Costs				
Bulls	$10/hd			
Cows and calves	$13/hd			
Weaners	$6/hd			
Yearlings	$10/hd			
Pasture maintenance	$14000/year			
Total area grazed	200 ha			
Cows joined	100			
Calves weaned	90%			
Number of bulls	3			
Weight of mature cows	600 kg		560	
Month when calves weaned	Dec		May	
Minimum age of calves at weaning	8 months		8 months	
Weight of calves at minimum weaning age	200 kg			
Annual death rate: Weaning-18months	2%			

Annual death rate: Adults	2%			
Calving calendar	Feb(22): Mar(62): Apr(16)		Aug(41): Sep(50): Oct(9)	
Steer Age	27 months (27.2 PVI analysed data)	23 months (22.8 PVI analysed data)	29 months (28.5 PVI analysed data)	22 months (21.5 PVI analysed data)
Percent sold	100%			
Steer Sale weight	562 kg (PVI analysed data)	556 kg (PVI analysed data)	589kg (PVI analysed data)	570kg (PVI analysed data)
Steer Sale price	200 c/kg			
Heifer Age	27 months (27.2 PVI analysed data)	23 months (22.8 PVI analysed data)	29 months (28.5 PVI analysed data)	22 months (21.5 PVI analysed data)
Percent sold	100%			
Heifer Sale weight	518 kg (PVI analysed data)	506 kg (PVI analysed data)	537 kg (PVI analysed data)	530 kg (PVI analysed data)
Heifer Sale price	195 c/kg			
Culled cows: weight	600 kg live		560 kg live	
Culled cow Price	150 c/kg live			
Culled bulls: weight	800 kg live			
Cull bull Price	155 c/kg live			

Stocking rate was determined by adjusting breeding cow numbers until the total feed deficit was 200kg DM/Ha

Table 6. Grass fed price grid from Cargill Beef showing specifications and discounts for the traits HSCW, butt shape, P8 fat depth, bruising, dentition, fat and meat colour

DATE:
CARGILL BEEF AUSTRALIA
BOX 166. WAGGA WAGGA, N.S.W. 2650
A DEPARTMENT OF CARGILL AUSTRALIA LTD.
A.B.N. 42 004 684 173

GRID

BUYER : QUOTE ENDS:

VENDOR: PVI Hamilton

YEARL-ING HSCW	GRID No. STEER	HEIFER		YEARLING CODE	BUTT SHAPE	FAT MM	BRUISE CODE	DENT	FAT COL-OUR	MEAT COL-OUR	PREM DISC
396 +	2.96	2.92									
356 - 395.9	3.4	3.36	Base	1	A-C	6 - 17	NIL	0-2	0-3	1A-3	0.1
300 - 355.9	3.46	3.42		D02	A-C	6 - 22	1-4	0-2	0-3	1A-7	0
275 - 299.9	3.4	3.36		D03	A-C	23 - 32	1-4	0-2	0-3	1A-7	-0.05
250 - 274.9	3.32	3.28		D04	A-C	33 - 42	1-4	0-2	0-3	1A-7	-0.15
230 - 249.9	3.16	3.12		D05	A-D	4 - 17	1-4	0-2	0-3	1A-7	-0.05
200 - 229.9	2.36	2.32		D06	A-D	18 - 22	1-5	0-2	0-3	1A-7	-0.2
<199.9				D07	A-D	0 - 50	1-9	0-2	0-3	1A-7	-0.4
PRIME							PRIME				
HSCW				M01	A-C	6-17	1 -4	4	0-3	1A-4	0.2
396 +	2.5	2.45		M02	A-C	6 -22	1 - 4	4	0-3	1A-7	0.1
356-395.9	2.7	2.65	Base	M03	A-C	6-17	1-7	4-7	0-4	1A-4	0.05
300-355.9	2.75	2.7		M04	A-D	4-22	1-7	4-7	0-4	1A-7	0
275-299.9	2.7	2.65		M05	A-D	23-32	1-9	4-7	0-5	1A-7	-0.1
250-274.9	2.6	2.55		M06	A-D	33-42	1 - 9	4-7	0-6	1A-7	-0.3
230-249.9	2.45	2.4		M07	A-D	43-49	1-9	4-7	0-7	1A-7	-0.4
200-229.9	1.9	1.85		M08	A-E	0+	1-9	4-7	0-7	1A-7	-0.65
<199.9											
No. HEAD											