Harper Adams University Beef Unit – Management Summary 2013/14

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Introduction

The Harper Adams University beef unit is based on finishing dairy-bred bull calves from the college's 340 head dairy herd. The majority of the bulls are Holsteins with some Continental and Angus cross Holsteins. The cattle are finished intensively on either a cereal beef system with concentrates fed *ad lib* with straw, or on a silage beef system with restricted quantities of concentrates to slaughter at 13-15 months old. Weaned suckled calves are also occasionally purchased for 'yard finishing'. The beef unit provides opportunities for trial work to be carried out, including projects for commercial organisations, education and demonstration purposes.

The university has also recently agreed the tenancy of 178 hectares (440 acres) of mixed farmland near Telford. Some of the grassland is used to extensively finish Hereford and Angus cross Holstein calves from the dairy unit at 22-24 months old to supply beef to the Harper Adams catering department.

Reasons for Intensive Beef Production

Beef production at Harper Adams is a secondary enterprise to dairy and arable cropping. However there is good integration with the beef unit rearing calves from the dairy herd and using home grown forage and cereals for feed, straw for bedding with the beef cattle supplying manure for the arable ground.

Most beef systems usually require a significant amount of working capital and therefore attention to all management aspects are a prerequisite for generation of profits. Profitability is very sensitive to the relationships between the purchase price of calves, feed costs and the sale value of the finished animal. Profitable beef production requires:

- A high standard of management
- Utilisation of home grown feed and efficient feed conversion
- Appropriate breed selection and use of easy calving High (Top1-10%) Terminal Index sires
- A low fixed cost structure
- Focus on marketing.

At Newport land cannot be justified for a grazing based beef system so therefore an indoor finishing system offers the only opportunity for a beef enterprise at the University campus.

The Harper Adams Beef Unit

Cattle fed either via hoppers or troughs

Performance Summary

The performance results from some recently finished beef cattle at Harper Adams are summarized in table 1.

Table 1 – Recent cereal bull beef performance results Harper Adams

Breeds	Holstein	Continental x Holstein	Angus x Holstein
Slaughter wt (kg)	566	593	554
Age at slaughter (months)	14.0	14.3	12.8
DLWG from birth (kg)	1.23	1.27	1.32
DLWG from 12 weeks old (kg)	1.33	1.37	1.45
Carcase wt (kg)	291	332	289
Kill out (%)	51.4	56.0	52.2
Carcase DG from birth (kg)	0.63	0.71	0.69
Carcase classification	-O3	R/O+3	O+4L
Finishing concentrates	2,510	2,395	2,210
FCR (from 12 wks)	5.57	5.01	5.03

Full gross margin details are shown in Appendix 1.

12 month old Holstein bulls

7/8th Bred Limousin suckled bulls

Beef Unit Management Summary

Calf Rearing

Achieving early and adequate intake of high quality colostrum is the single most important management factor in determining calf health and survival. Colostrum is rich in nutrients but most importantly immunoglobulins (lg) or antibodies, which provide the calf with passive immunity.

The priority with new born calves is ensuring at least 2 litres of colostrum is fed within six hours of birth with 10% of body weight fed in the first 24 hours. Colostrum is then fed for the next 3 days and at 4 days old the calf is then fed either whole milk or milk replacer twice per day (approx. 2-2.5 litres per feed) to weaning at 6-8 weeks. Fresh water, clean bright straw and palatable good quality 18% crude protein (CP) early weaning concentrates are offered *ad lib* from 7 days old. Weaning is dictated by concentrate intake with 1kg/calf/day being the target.

The calves are vaccinated Bovilis™ Bovipast RSP (MSD Animal Health) on arrival in the beef unit and at 4 weeks. Bulls are left entire and all calves are dehorned at 4-6 weeks old. The calves are housed in well-ventilated yards, which ensure adequate air space and change.

The calves are involved in commercially sponsored feeding trials and are individually penned and bedded on straw and moved into groups of 8 - 15 calves post weaning. Calves are sometimes reared in groups on computerized machine feeding regimes which restrict the quantity of milk fed to levels similar to bucket feeding. Some batches of calves have been reared on *ad lib* milk from automatic feeders. This latter system produces very high growth rates to weaning, however milk intake can average 8-12 litres per day. Calf live weights at 12 weeks old tend to be approximately 10-15kg heavier compared to restricted milk feeding systems.

Cereal Beef Production

The majority of beef cattle at Harper Adams are reared on the cereal beef system. The system is relatively simple to operate and involves feeding a concentrate diet *ad lib* to housed cattle to achieve high growth rates through to slaughter at 13-15 months of age.

With year round housing it is possible to rear bulls and therefore take advantage of their superior performance (+10%) above steers. The system suits late maturing breed types although it is possible to finish Continental x heifers, albeit at relatively light slaughter weights (260kg carcase wt). It is the most appropriate beef production system for Holstein bulls.

The calves enter the cereal beef unit at 12 weeks and are managed in groups of 8-10 per pen. Their early weaning concentrate is gradually changed to a 14% CP ration based on rolled barley which is offered *ad lib*. At 275kg liveweight the CP level is reduced to 12%. Typical rations fed at Harper Adams are shown in Table 2.

Table 2 – Harper Adams Cereal Beef Rations

	Crude Protein (% as fed)	
Feeds (kg/t)	**12%**	**14%**
Rolled Barley	750	685
Soya/rape	75	140
Beet Pulp or Soya Hulls	100	100
Molasses	50	50
Intensive Beef Minerals	25	25
ME (MJ/kg DM)	12.9	12.8
Starch (% in DM)	40.2	36.9

Barley is a key nutrient for the system. It provides high levels of energy from starch which optimises both daily live weight gain (DLWG) and feed conversion ration (FCR). It is lightly rolled which helps prevents rapid fermentation and therefore minimises problems with acidosis (barley poisoning). Feeding whole grain cereal results in a significant proportion of the grains passing through the animal undigested.

Up to 50% of the barley can be replaced with wheat if required. Beet pulp or Soya Hulls are included at 100kg/t since trials at Harper Adams have shown that this can have a positive effect on DLWG. Molasses is included as an energy source but mainly to dampen dust to help minimise associated respiratory problems. The ration is balanced to either 12 or 14% CP using a 50:50 mix of soya (44% CP) and rapeseed meal (36% CP).

A recently completed EBLEX funded trial at Harper evaluated the effect of protein level on the performance of 280kg bulls through to slaughter. Bulls were fed either 12%, 14% or 16% CP rations. There were no significant differences between the treatments. See Trial Report 2008(a) for further details. The CP level in the Harper beef ration is therefore reduced from 14% to 12% from 275kg liveweight through to slaughter by reducing the soya/rape to an inclusion rate of 75kg/t. Depending on the price of soya and rape this can reduce the cost of the finished ration by £2.60-£5.50/t.

Mineralisation of a cereal beef ration is vitally important especially to provide adequate calcium for bone development with a 'calcium to phosphorus ratio' of 1.5-2:1 in the finished ration. Proprietary minerals used within barley based rations should contain a high level of calcium (24%) low phosphorus and magnesium (3% or less) and 8-10% sodium together with the usual range of trace elements. Vitamins are also required with 300,000, 60,000 and 800 iu/kg for A, D_3 and E respectively. If moist grain is fed, the mineral should contain 1,500+ iu/kg of vitamin E.

Straw must be offered *ad lib* to provide long fibre for rumen function to minimize problems with bloat. Intakes are typically 0.5-1kg per day.

Bulls are slaughtered at target fat class 3 with Continental x Holstein heifers taken to fat class 4L in order to maximise carcass weight.

Relationship between Slaughter Weight and Feed Conversion Ratio (FCR)

It is well established that FCR deteriorates with increasing live weight. A point is reached within any cereal beef system that cattle start to lose money when daily feed costs exceed the value of live weight gain. Factors such as market requirements for both fat classification and slaughter weight must be taken into consideration, as well as the cost of the finishing ration. Typical FCR's for Holstein bulls are shown in Table 3. The deterioration in FCR with Continental cross bulls takes place at heavier weights.

Table 3 - Feed Conversion Ratios for Holstein Bulls

Live weight (kg)	420	460	500	540	580
FCR (kg feed: kg gain)	6.3	7.1	7.8	8.8	9.9

(Source: Lewis, 1999)

Calculation of the optimum slaughter weight must also include items such as interest charges and sundry costs such as bedding etc.

Performance Targets

Targets for cereal fed dairy-bred beef cattle are shown in Table 4

Table 4 - Cereal Beef System Targets for dairy-bred Calves

	Holstein bulls	Continental x Holstein bulls	Continental x Holstein heifers
Slaughter age (months)	14	14	13
Slaughter wt (kg)	570	600	470
DLWG from birth (kg)	1.24	1.31	1.10
DLWG from 12 wks old (kg)	1.35	1.40	1.18
Carcase wt (kg)	285	335	250
Daily carcase gain from birth (kg)	0.61	0.73	0.58
Killing out %	51	56	53
Carcase classification	-O3	O+/R3	O+4L
Finishing concs (t)	2.50	2.42	1.95
FCR (3 months-slaughter)	5.5	5.0	5.4

* Killing out % based on empty gut weight and UK carcase dressing specification

The majority of the meat trade which supply supermarkets will penalise lightweight (below 260kg) carcasses produced by intensively fed heifers. The main market outlet for this type of carcase should be the small 'local' butcher. Early maturing beef bred heifers should not be reared on an intensive beef system.

Early maturing beef bred bulls such as Hereford and Aberdeen Angus crosses will typically finish at carcase weights under 260kg at fat class 4L. However, the recent introduction of Canadian genetics into some of the Aberdeen Angus and Hereford bloodlines can enable these breed types to achieve higher carcase weights and a recent batch of Angus x Holstein bulls recorded an average carcase weight of 292kg.

Crimped grain maize

There is growing interest in feeding grain maize to cattle due to its high energy (14.5 ME MJ/kg DM) and starch (71% in DM) content. A relatively high proportion (35%) of the starch is rumen undegradable (DUP) compared to 15% for rolled barley which should help minimise problems with rumen acidosis. In 2009/10 a batch of bulls were finished on grain maize and recorded significantly higher DLWGs that bulls fed on rolled barley. Full details are available in Trial Report 2010(c).

Co-product feeds

Other alternative feeds to rolled barley are co-product feeds such as Brewers Grains and Traffordgold. In 2009 a batch of bulls were finished on a blend of Traffordgold, processed bread and beet pulp. Full details are available in Trial Report 2009(a).

The future for Black & White bulls

The most appropriate production system for Holstein bulls is the intensive cereal beef system. As mentioned previously profitability is very sensitive to the relationships between the purchase price of calves, feed costs and the sale value of the finished animal. A scenario of high cereal prices and low finished beef prices results in increased numbers of Holstein bull calves being shot at birth. It is estimated that in 2012 of the 452,000 dairy-bred bull calves born in Great Britain that 55,000 were dispatched at birth and 78,000 slaughtered as bobby calves.

At Harper Adams we know our costs of production which are as follows; calf rearing costs to 12 weeks @ £102.03/calf; haulage @ £10/bull; abattoir costs @ £16.25. We have zero straw bedding cost since we are a 'muck for straw' agreement. It is easy to therefore predict gross margins for a range of feed and finished beef prices based on achieving target performance of a 280kg carcase at

14 months old with 2.50t of feed and a calf valued at £60.

Table 5: Predicted gross margins for Holstein bulls achieving target performance at Harper Adams for a range of feed and finished beef prices.

	Beef price (-O grade £/kg carcase wt)		
Feed cost (£/t)	**3.25**	**3.50**	**3.75**
175	285	355	425
200	222	292	362
225	160	230	300
250	97	167	237

Gross margins are not profit and as guide you need to earn £10/head/month gross margin to cover fixed costs. A bull beef system achieving target performance with a gross margin under £130/head is losing money. Our last batch of Holstein bulls sold for £3.53/kg (May 2013) with a feed cost of £201/t so a profit was made.

Data from a major abattoir has recently been analysed by Harper Adams for over 250 Holstein bulls reared on commercial beef units. The results were a surprise! The mean carcase weight was 274kg at a slaughter age of 15.1 months whereas the recognised targets are a 285kg carcase at 14 months old. Many intensive finishers are not therefore achieving target performance. Target performance must therefore be achieved.

Purchased Suckled Calves

When pens are available weaned suckled bull or steer calves at 7-10 months old are purchased for intensive yard finishing. The preference is to buy ¾ Continental cross suckled calves and to buy them direct from the breeder thus minimising stress and disease risk. The stipulation when buying weaned calves is that they must have been fed *ad lib* creep feed for at least one month prior to purchase and vaccinated against the main respiratory viruses i.e. BVD, RSV, IBR and Pi3. On arrival at Harper Adams the calves are kept initially on *ad lib* creep. They are not put under any stress and are housed in a well-ventilated straw-bedded yard with access to good quality forage. After about 14 days when they are first weighed they are treated with an anthelmintic to protect against external and internal parasites including liver fluke.

Targets for intensively finishing weaned suckled calves are shown in table 6.

Table 6 - Cereal Beef System Targets for Continental cross weaned Suckled Calves

	Charolais x Lim/Hol bull	3/4 bred Continental steer	3/4 bred Continental heifer
Weaned calf @ 8 months old (kg)	350	325	300
Slaughter age (months)	14	13.5	13.5
Slaughter wt (kg)	650	570	530
DLWG wean to slaughter (kg)	1.64	1.46	1.31
Carcase wt (kg)	385	325	290
Daily carcase gain from birth (kg)	0.84	0.73	0.64
Killing out %	59	57	55
Carcase classification	-U/U+3	R/-U3	R4L
Concs (kg)	1,800	1,525	1,400
FCR (kg feed: kg gain)	6.00	6.22	6.36

With dairy-bred bulls slaughter should be dictated by FCR and fat cover, with most bulls slaughtered below 600kg. However with ¾ Continental bred suckler bulls recent work by Keady and Kilpatrick (2006) has shown that these bulls can be taken up to weights of 800kg (460kg carcase) without a significant deterioration in FCR with growth rates at a constant 1.4-1.5kg/day from weaning on an intensive cereal finishing system. Slaughter can therefore be dictated by the carcase weight required by the market.

A key factor influencing profitability with any beef production system is to rear cattle bred from good quality high index bulls, i.e. bulls with a high (Top 1-10%) Terminal Index.

Silage Beef Production

This system is based on feeding *ad lib* forage plus a restricted quantity of concentrates to achieve moderate-high growth rates through to slaughter at 14-16 months of age. The success of the system is based on feeding very good quality (11.0+ ME MJ/kg DM) forage. Like the cereal beef system with year round housing it is possible to rear bulls. The system suits late maturing breed types. Compared to the cereal beef system, lower growth rates are achieved, however cattle tend to be slaughtered older at slightly heavier weights. Target performance is shown in table 7. The silage can be either grass, maize or whole crop. The choice of which forage to grow will depend primarily on yield and feed value for the locality.

Table 7 - Target Performance for Continental x Holstein bulls calves reared on Intensive Beef Systems

	Cereals	Grass Silage	Maize Silage
Start wt @ 12 wks old (kg)	120	120	120
Slaughter age (mo)	14	15.5	15.5
Slaughter wt (kg)	600	630	630
DLWG from 12 wks old (kg)	1.40	1.35	1.35
Carcase wt (kg)	335	345	345
Killing out %	56	55	55
Forage (kg)	300 (straw)	6,000 @ 25% DM	5,000 @ 30% DM
Rolled barley (kg)	1,985	1,170	825
35% CP Concs (kg)	365	130	275

Silage Quality

Silage must be well made with good intake characteristics and fed *ad lib*. The key factor dictating cattle growth rates is the energy (ME) content of the silage as shown in table 8.

Table 8 – Effect of silage energy content on level of concentrate supplement required for a 400kg bull gaining 1.2kg/day

ME content (MJ/kg DM)	11.2	10.9	10.6	10.2	9.9	9.6	9.3
Concs (kg/head/day)	1.9	2.3	3.1	3.9	4.5	5.0	5.5

The crude protein content of the concentrates is dependent on the forage. With grass silage, concentrates can simply be mineralised rolled barley. With maize silage and fermented whole crop the concentrates should contain 16-18% crude protein.

Maize Silage for Beef Cattle

In 2008/09 a batch of bulls were finished on some good quality maize silage fed either 50:50 or 75:25 on a dry matter basis with concentrates. The rations were balanced to contain an overall CP

content of 14% (in DM). See table 9 for a summary of the results and Trial Report 2009(b) for full details.

Table 9 – Effect of concentrate feed level on the performance of maize silage fed Holstein bulls

	75% Maize 25% Concs	50% Maize 50% Concs
Age at slaughter (months)	15.3	15.2
Wt at start (kg)	224	225
Wt at slaughter (kg)	587	585
Days to slaughter	276	272
DLWG (kg)	1.32	1.33
Carcase wt (kg)	295	296
Finishing concentrates (kg)	691	1,480
Maize silage (kg)	5,029	3,843
FCR (kg DM/kg gain)	6.39	7.20

As can be seen from table 8 there was no benefit from feeding a higher level of concentrates. The proviso on this comment is that the maize was very good quality @ 33.9% DM, 11.3ME and 30.5% starch. The bulls were approximately 1½ months older at slaughter compared to our usual cereal fed bulls.

Whole crop for Beef Cattle

Bulls can be successfully finished on whole crop. Winter wheat is the preferred cereal for whole crop. Fermented whole crop should be made with the crop 'green going yellow' and the grain texture of soft cheddar. At Harper Adams, fermented whole crop is typically made with winter wheat in mid-late July. Cracked urea treated whole crop (Alkalage) is made at 70-80% DM with a very hard grain texture and made in mid August about 7 days prior to conventional harvest with a forager with a grain processing mill in order to crack the grains. Increasing the cutting height increases the energy and starch content of Alkalage and minimizes the use of concentrates. In 2003 and 2005 experiments were carried out to compare the performance of Continental x beef cattle finishing on various types of whole crop. The results are detailed in trial reports 2003(b) and 2005(a).

Rosé beef production

In 2013 a batch of Holstein bulls were reared on a Rosé beef system fed *ad lib* beef nuts. The definition of Rosé beef is that age of slaughter is under 12 months old (veal is defined as up to 8 months old).

Compared to traditional Cereal finished Holstein bulls, the Rosé Holstein bulls recorded higher (P<0.01) DLWGs and were slaughtered at significantly lower (P<0.01) slaughter and carcase weights with a lower (P<0.05) fat classification. The FCR (kg feed: kg LW gain) of the Rosé bulls was improved from 5.72 to 5.14 with total concentrate feed intakes reduced by 443kg/bull. The gross margins per bull were similar however with the earlier slaughter of the Rosé bulls the margin per bull place was improved by £48. A market outlet should be secured before entering into Rosé Beef production. See appendix 1 and trial report 2013(a) for further details.

Semi-intensive beef production

At our tenanted farm at Telford native breed crosses are reared on a semi intensive beef production system. The system is based on finishing Hereford and Angus cross Holstein steers and heifers at

22-24 months old @ 560kg and 490kg respectively to supply beef to the Harper Adams catering department.

Attention is focused on the following key areas:

- Maximising performance at grass on 'clover rich' swards with target sward heights of 7-9cm throughout the grazing season.
- Winter forages made with sufficient feed value to minimise/eliminate concentrate feed use.
- Utilisation of compensatory growth.
- Rearing progeny from 'High Terminal Index' Beef Bulls. We have recently purchased 2 easy calving, high growth and eye muscle area EBV Hereford bulls. One runs with the low yielding cows with the other with replacement heifers.
    - Alderville 1 Ledbury has an EBV for Calving Ease Direct of +2.3% putting him in the top 20% for the breed, +55kg for his 400 day wt (top 15%) and Eye Muscle Area of +1.9 sq cm (top 20%) with a Terminal Index of +27 (top 20% for the breed).
    - Thornby 1 Hubert has an EBV for Calving Ease Direct of +0.5%, +62kg for his 400 day wt and Eye Muscle Area of +4.0 sq cm (top 1%) with a Terminal Index of +32 (top 5% for the breed).
- Out-wintering on forage brassicas to minimise fixed costs

Current Trial work

Shown below are the trials currently in progress at Harper Adams:

- Effect of reducing the starch content of intensive beef rations by the replacement of barley and rapeseed meal with distillers grains and evaluation of digestible undegraded protein (DUP) for young bulls (funded by Carrs Billington)
- Evaluation of a protected fat supplement (Megalac®, Volac International Ltd) on the performance of intensively finished bulls.
- Evaluation of early weaning concentrate quality on the performance and health of artificially reared beef calves to 12 weeks (funded by Bonanza Calf Nutrition)
- Evaluation of calf coats (Woolovers) on the performance and health of artificially reared beef calves to 12 weeks (funded Wynnstay Group Plc)

Previous Years Trials

A number of trials have been carried out over recent years and include the following:

<u>Breeding & Beef Systems</u>

2013(a) Evaluation of Rosé and Cereal Beef Production for Holstein bulls and Cereal Beef Production for Angus x Holstein bulls
2012(d) Evaluation of progeny from Angus bulls with Top 10% and Top 70% Terminal Indexes
2007(c) Evaluation of progeny from Limousin bulls with Top 1% and Bottom 1% Beef Values
2006(c) Evaluation of progeny from Limousin bulls with Top 1% and Top 10% Beef Values
2000(a) Evaluation of progeny from Top 10% and Bottom 25% Beef Value Limousin bulls.
1997(a) Comparison of the performance of bulls, steers and heifers
1996 Preliminary evaluation of the Parthenais beef breed

<u>Nutrition</u>

2013(b) Effect of reducing the starch content of cereal based rations by the partial replacement of barley with soya hulls for intensively finished bulls

2012(a) Oats for intensively finished bulls

2012(b) Effect of feeding a Yeast Culture (Diamond V XP_{LS}) on the performance of intensively finished bulls.

2011(b) Alkagrain for finishing beef cattle

2010(c) Crimped maize grain for finishing beef cattle.

2009(a) Evaluation of Traffordgold, Bread and Sugar Beet Feed mix on the performance of intensively fed bulls.

2009(b) Effect of concentrate feed level on the performance of maize silage fed bulls.

2008(a) Effect of dietary crude protein level on the performance of cereal fed Holstein bulls.

2008(b) Evaluation of rapeseed meal and a urea based concentrate (Promol 80) for cereal fed beef cattle.

2006(b) Effect of feeding a compound feed with high or low starch content on the performance of intensively Holstein bulls

2005(a) Evaluation of head-cut whole crop wheat and barley for finishing beef cattle

2004(a) Evaluation of Acid Buf on the performance of cereal fed beef cattle

2004(b) Evaluation of Yea-Sacc^{1026} on the performance of cereal fed beef cattle

2004(c) Evaluation of CRINA® on the performance of cereal fed beef cattle

2003(b) Whole crop wheat for intensively finished beef cattle

2001(b) Processed urea-treated whole crop wheat (Alkalage) for beef cattle

2000(b) Fermented whole crop wheat for beef cattle

1999(a) Evaluation of pressed sugar beet pulp ensiled with maize distillers dark grains (Praize) for intensively finished suckled bulls.

1999(b) Protein levels for intensively fed beef cattle

1998 Evaluation of Co-product rations to finish heifers at high slaughter weights

1997(b) Pressed sugar beet pulp ensiled with barley distillers grains for intensively finished beef cattle

1995 Co-product feeds for intensively finished beef cattle

1994 Evaluation of barley distillers dark grains and Molassed Sugar Beet Feed for intensively finished beef cattle

1993 Evaluation of moist crimped barley for intensively fed beef cattle

1992 Evaluation of Molassed Sugar Beet Feed for intensively finished beef cattle

Calf Rearing

2103(c) Evaluation of feeding high (750g) or standard (500g) levels of milk replacer on the performance of artificially reared beef calves to 12 weeks

2013(d) Teat versus bucket feeding systems for calves

2012(c) Effect of rearing purchased calves on either milk replacer containing 20% CP fed once per day or milk replacer containing 26% CP twice per day on performance of dairy-bred beef calves to 12 weeks

2012(d) Effect of milk replacer oil content on the performance and health of dairy-bred beef calves to 12 weeks

2011(a) Effect of feeding a Yeast Culture (Diamond V XP_{LS}) on the performance of artificially reared dairy-bred bull calves

2011(c) Effect of once or twice per day milk replacer feeding systems on performance of purchased 3 week old dairy-bred beef calves to 12 weeks

2010(a) Evaluation of skim and whey based milk replacers on the performance of artificially reared dairy-bred bull calves

2010(b) Effect of early weaning concentrate pellet size on the performance of artificially reared dairy-bred bull calves

2008(c) Effect of feeding either a coarse mix or pelleted early weaning concentrates to bucket reared calves.

2008(d) Effect of weaning dairy-bred calves either gradually or abruptly.

2007(a) Effect of rearing calves either individually in pens and bucket fed milk twice per day or group housed and fed a computerized machine.

2007(b) Comparison of once versus twice per day milk replacer feeding systems with 5 day old bucket reared calves.

2006(a) Effect of weaning calves at low (0.75kg) or high (1.25kg) levels of concentrate intake on performance to 12 weeks of age

2003(a) Feeding either high or low levels of milk replacer to dairy-bred beef calves to weaning at 6 weeks old

2002 Feeding either whole milk or milk replacer and weaning dairy-bred beef calves at either 6 or 8 weeks old

2001(a) Yeast cultures (Diamond V XP_{LS} Yeast) for artificially reared beef calves.

1999(c) Comparison of weaning dairy bred calves at either 5 or 7 weeks old & Comparison of whole milk versus calf milk replacer for dairy bred calves weaned at 5 weeks old

Copies of the above trial reports are available from Simon Marsh (Tel: 01952 815213, E-mail: smarsh@harper-adams.ac.uk)

Recent gross margins are shown in Appendix 1 on the following page.

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Appendix 1.

Harper Adams Beef Unit - Gross Margins - 2012/13

Stock: Sept 2011-Oct 2011 born dairy-bred bulls. Sold Oct 2012- Dec 2012

Financial performance (£/bull)	Holstein	Continental x Holstein	Angus x Holstein
Output			
Sales	966	1169	974
Less calf purchase	49	252	146
Total Output	**917**	**917**	**828**
Variable Costs			
Calf rearing costs to 3 months	102	102	102
Finishing concentrates	507	484	446
Vet & medicines	6	6	6
Bedding & other costs	23	23	23
Total Variable Costs	**638**	**615**	**577**
Gross Margin/Head	**279**	**302**	**250**
Physical Performance			
Age at slaughter (months)	14.0	14.3	12.8
Birth wt (kg)	40	43	38
Slaughter wt (kg)	566	593	554
DLWG (kg from birth)	1.23	1.26	1.32
DLWG (kg from 12 wks old)	1.33	1.37	1.45
Carcase wt (kg)	291	332	289
Daily carcase gain (kg from birth)	0.63	0.71	0.68
Daily carcase gain (kg from 12 weeks)	0.70	0.80	0.75
Killing out %[1]	51.4	56.0	52.2
Carcass classification	-O3	R3	O+4L
Feeds (kg)			
Milk replacer @ £1,500/t	24	24	24
Calf concentrates @ £250/t	122	124	119
Finishing concentrates	2,510	2,395	2,210
FCR (kg feed/kg gain)	5.05	4.62	4.56
FCR (12 weeks - slaughter)	5.50	5.01	5.03
Prices			
Sale price (£/kg live weight)	1.71	1.97	1.76
Sale price (£/kg carcase weight)	3.32	3.52	3.44
Finishing concs (£/t)[2]	202	202	202

Supplementary Information:

[1] Killing out percentage appears relatively low however it must be noted that the bulls were weighed 'gut full' prior to slaughter.

[2] From 3 months to slaughter bulls fed *ad lib* 14% CP Barley Beef Mix @ £202/t (67.5% rolled barley @ £172/t, 10% soya hulls @ £165/t, 7.5% soyabean meal @ £374/t, 7.5% rapeseed meal @ £220/t, 5% molasses @ £155/t, 2.5% minerals @ £350/t Plus £10/t mill & mix charge).

Stock: Jan-Mar 2012 born dairy-bred bulls. Sold Jan 2013-May 2013

	Angus x Holstein	Holstein	
Financial performance (£/bull)	**Cereal**	**Cereal**	**Rosé**
Output			
Sales	1045	928	844
Less calf purchase	141	46	46
Total Output	**904**	**882**	**798**
Variable Costs			
Calf rearing costs to 3 months	102	102	102
Finishing concentrates	475	479	390
Vet & medicines	7	7	7
Bedding & other costs	24	25	23
Total Variable Costs	**608**	**613**	**522**
Gross Margin/Head	**297**	**269**	**276**
Gross Margin/Head/Year	**258**	**233**	**281**
Physical Performance			
Age at slaughter (months)	13.8	13.9	11.8
Birth wt (kg)	39	41	41
Slaughter wt (kg)	562	528	489
DLWG (kg from birth)	1.24	1.15	1.24
DLWG (kg from 12 weeks old)	1.34	1.22	1.37
Carcase wt (kg)	292	269	246
Daily carcase gain (kg from birth)	0.65	0.58	0.63
Daily carcase gain (kg from 12 weeks)	0.72	0.64	0.70
Killing out %	52.0	50.9	50.3
Carcase classification	O+3	-O3	-O2/3
Feeds (kg)			
Milk replacer @ £1,570/t	23	23	23
Calf concentrates @ £296/t	124	124	124
Finishing concentrates @ £201/t	2,361	2,381	1,938
FCR (kg feed/kg gain)	4.80	5.19	4.65
FCR (12 weeks - slaughter)	5.22	5.72	5.14
Prices			
Sale price (£/kg live weight)	1.86	1.76	1.73
Sale price (£/kg carcase weight)	3.58	3.45	3.43

From 3 months to slaughter the bulls were fed on Wynnstay Primebeef Premium nuts