

## **Harper Adams University Beef Unit – Management Summary 2016/17**

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### **Introduction**

The Harper Adams University beef unit is based on finishing dairy-bred bull calves from the university's 390 head dairy herd. The majority of the bulls are Holstein and Continental 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 the tenancy of 178 hectares (440 acres) of mixed farmland near Telford. Some of the grassland is used to extensively finish Hereford cross Holstein calves from the dairy unit at 19-22 months old.

### **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. Full gross margin details are shown in Appendix 1.

**Table 1 – Recent cereal bull beef performance results Harper Adams**

Breeds	Holstein	British Blue x Holstein	Angus x Holstein
Slaughter wt (kg)	572	616	554
Age at slaughter (months)	13.3	13.1	12.8
DLWG from birth (kg)	1.31	1.43	1.32
DLWG from 12 weeks old (kg)	1.43	1.58	1.45
Carcase wt (kg)	288	338	289
Kill out (%)	50.5	55.0	52.2
Daily carcase gain from birth (kg)*	0.71 (0.65)	0.84 (0.79)	0.74 (0.69)
Carcase classification	-O3	R3	O+4L
Finishing concentrates	2,737	2,645	2,210
FCR (from 12 wks)	5.92	5.28	5.03

\*DCG in bracket deducts 24kg for the bull calf birth carcase weight.



*12 month old Holstein bulls*



*7/8<sup>th</sup> Bred Limousin suckled bulls*

## Beef Unit Management Summary

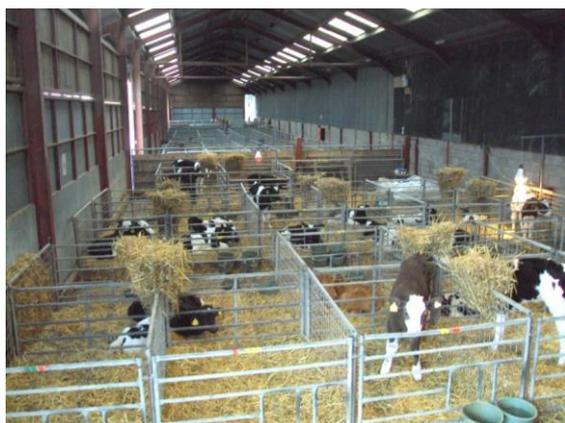
### Calf Rearing

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 (Ig) 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 - 12 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.



*Harper Adams Calf Unit*



*Computerized machine group reared calves*

### 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 carcass 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% with Holstein bulls. Typical rations fed at Harper Adams are shown in Table 2.

**Table 2 – Harper Adams Cereal Beef Rations**

Feeds (kg/t)	Crude Protein (% as fed)	
	12%	14%
Lightly Rolled Barley	750	685
Soya/distillers (50:50)	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 ratio (FCR). It is lightly rolled (not ground) which helps prevent 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 distillers grains (28% CP).

An AHDB funded trial at Harper Adams evaluated the effect of protein level on the performance of 280kg Holstein bulls through to slaughter. Bulls were fed 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/distillers to an inclusion rate of 75kg/t. Depending on the price of soya and distillers this can reduce the cost of the finished ration by £5-£13/t. However genetic improvement and sire selection for higher productivity and lean tissue deposition have substantially increased the protein requirement with Continental bred cattle and a recently completed study to evaluate 12% versus 14% CP rations with 320kg Continental x Holstein bulls recorded improved DLWGs (1.42 v 1.48kg) with feeding the higher CP ration. See Trial Report 2015(a) for further details. A study has also recently been complete to evaluate feeding elevated levels of digestible undegradable protein (DUP) to young bulls. See Trial Report 2015(c) for further details.



*Continental x Holstein bulls*



*Charolais x Lim/Fr finishing heifers*

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<sub>3</sub> 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 0.3-0.9kg 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 growth rates, feed intakes and 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 – Typical monthly growth rates, feed intakes and FCRs for Holstein Bulls**

Age (months)	Weight (kg)	DLWG (kg)	Daily feed intake (kg)	DMI % of body weight	Feed per month (kg)	FCR
3	110	1.25	3.8	2.55	116	3.05
4	148	1.38	4.5	2.25	137	3.27
5	190	1.64	5.5	2.14	168	3.36
6	240	1.80	6.5	2.00	198	3.60
7	295	1.64	7.0	1.75	214	4.27
8	345	1.48	7.5	1.61	229	5.08
9	390	1.36	8.3	1.56	252	6.29
10	430	1.31	9.0	1.55	275	6.86
11	470	1.20	9.8	1.53	297	8.50
12	505	1.15	10.5	1.54	320	9.15
13	540	0.98	11.4	1.56	348	11.59
14	570			<b>Total</b>	<b>2,553</b>	

The above feed intakes relate to cereals. They do not include straw which is approximately 0.3kg per head per day at 3 months old and 0.9kg at 13 months old. Calculation of the optimum slaughter weight must also include items such as interest charges and sundry costs such as bedding etc. However the most appropriate option is usually to sell Holstein bulls as soon as they fall into the minimum acceptable fat class.

### 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 carcass gain from birth (kg)	0.67 (0.61)	0.78 (0.73)	0.63 (0.58)
Killing out %	51	56	53
Carcass classification	-O3	O+/R3	O+4L
Finishing concs (t)	2.55	2.42	1.95
FCR (3 months-slaughter)	5.5	5.0	5.4

Notes: Killing out % based on 'gut full' weight and UK carcass dressing specification. The daily carcass gain calculation in brackets deducts 24kg for the bull calves birth carcass weight. Most abattoirs do not deduct 24kg when displaying DCG on the kill sheets.

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 carcass 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 carcass 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 carcass weights and a recent batch of Hereford x Holstein bulls recorded an average carcass weight of 313kg.

### **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 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 than 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.

At Harper Adams we know our costs of production which are as follows; calf rearing costs to 12 weeks @ £98/calf; haulage @ £10/bull; abattoir costs @ £19.25. We have zero straw bedding cost since we have 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 carcass at 14 months old with 2.55t of feed and a calf valued at £50.

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

Feed cost (£/t)	Beef price (-O grade £/kg carcass wt)		
	2.75	3.00	3.25
125	288	359	431
150	224	296	367
175	161	232	303
200	97	168	239
225	33	104	176

Gross margins are not profit and as guide you need to earn at least £10/head/month gross margin to cover fixed costs. A bull beef system achieving target performance with a gross margin under £140/head is losing money. Gross Margins for recent batches of Holstein bulls at Harper Adams are shown in appendix 2.

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 carcass weight was 274kg at a slaughter age of 15.1 months whereas the recognised targets are a 285kg carcass at 14 months old. Many intensive finishers are not achieving target performance.

### **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  $\frac{3}{4}$  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 plus the clostridial diseases. On arrival at Harper Adams the cattle are not put under any stress and are housed in well-ventilated straw-bedded yards with access to good quality forage with concentrates gradually built up to *ad lib*. 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 finished 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)	360	340	310
Slaughter age (months)	14	13.5	13.5
Slaughter wt (kg)	650	590	540
DLWG wean to slaughter (kg)	1.60	1.49	1.37
Carcass wt (kg)	385	330	290
Daily carcass gain from birth (kg)	0.90 (0.84)	0.79 (0.73)	0.76 (0.64)
Killing out %	59	57	55
Carcass classification	-U/U+3	R/-U3	R4L
Concentrates (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 carcass) 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 carcass 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. Some markets penalize bulls over 16 months old which needs to be taken into consideration. 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, but it MUST be good quality silage.

**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
Carcass 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 the 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 carcass 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 since many abattoirs do not accept bulls under 12 months old. See 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 cross Holstein/Friesian steers and heifers at 19-22 months old @ 540-580kg (300-330kg carcass).

Attention is focused on the following key areas:

- Winter forages made with sufficient feed value to minimise/eliminate concentrate feed use.
- Maximising performance at grass on clover rich pastures with target sward heights of 7-9cm throughout the grazing season
- Utilisation of compensatory growth.
- Rearing progeny from 'High Terminal Index' Beef Bulls. A Simmental bull is used for AI on the cows. We also have a Hereford stock bull on the farm to serve PD- low yield cows and replacement heifers following AI programmes. Details of the bulls are as follows:
  - The Simmental AI bull currently used is Falondene Cincinnati from Cogent. Cincinnati has an EBV for Calving Ease Direct of +1.6% putting him in the top 25% for the breed, short gestation length (-1.6 days) and +60kg for his 400 day wt (top 30%) with a Terminal Index of +78 (top 30% for the breed).
  - The Hereford stock bull is Normanton 1 Leopold. He has an EBV for Calving Ease Direct of +4.4% (top 5%) and Eye Muscle Area of +3.1sq cm (top 5%) with a Terminal Index of +30 (top 10% 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:

- Comparison of the performance of bulls versus steers.
- Evaluation of the replacement of barley with wheat with diets containing nutritionally improved straw (NIS) on the performance of intensively finished bulls (funded by Sundown Products Ltd).
- Evaluation of 140 and 160g/kg DM crude protein rations for maize silage fed 300kg continental cross dairy-bred finishing heifers.
- 'Calf to Carcass' on a low cost outdoor forage system for October born Hereford x Friesian and Holstein-Friesian steers finishing at 20 months old (funded by AHDB, Hereford Cattle Society and Dunbia).
- Evaluation of feeding elevated levels of milk replacer (600 v 900g) on the performance of artificially reared beef calves to 12 weeks (funded by Trouw Nutrition GB).
- Evaluation of diurnal feeding patterns of milk on the performance of artificially reared beef calves to 12 weeks (funded by Bonanza Calf Nutrition).

## Previous Years Trials

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

### Breeding & Beef Systems

- |                 |   |
|-----------------|---|
| <b>2016(e)</b>  | Evaluation of progeny from terminal and maternal Simmental bulls.   |
| <b>2013(a)</b>  | Evaluation of Rosé and Cereal Beef Production for Holstein bulls and Cereal Beef Production for Angus x Holstein bulls. |
| <b>2012(d)</b>  | Evaluation of progeny from Angus bulls with Top 10% and Top 70% Terminal Indexes.                                       |
| <b>2007(c)</b>  | Evaluation of progeny from Limousin bulls with Top 1% and Bottom 1% Beef Values.  |
| <b>2006(c)</b>  | Evaluation of progeny from Limousin bulls with Top 1% and Top 10% Beef Values.  |
| <b>2000 (a)</b> | Evaluation of progeny from Top 10% and Bottom 25% Beef Value Limousin bulls.  |
| <b>1997(a)</b>  | Comparison of the performance of bulls, steers and heifers.   |
| <b>1996</b>     | Preliminary evaluation of the Parthenais beef breed.  |

## **Nutrition**

- 2016(d)** Evaluation of the partial replacement of barley with maize meal on the performance of intensively finished bulls.
- 2016(a)** Partial replacement of barley with wheat and soya hulls with nutritionally improved straw (NIS) with 240kg dairy bred bulls.
- 2015(c)** Evaluation of increasing the digestible undegradable protein (DUP) supply to 135kg cereal fed dairy bred bulls.
- 2015(a)** Evaluation of 12% and 14% crude protein rations for 300kg intensively finished Continental dairy-bred bulls.
- 2014(c)** Evaluation of the partial replacement of wheat and rapeseed meal with distillers grains and increasing the digestible undegraded protein content of beef rations with AminoMax-R for intensively finished dairy-bred bulls.
- 2014(b)** Evaluation of 13% versus 16% crude protein creep rations for Autumn born suckled calves.
- 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 XPLS) on the performance of intensively finished bulls.
- 2011(b)** Alkagrain for finishing beef cattle.
- 2010(c)** Crimped grain maize 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.
- 2008(e)** Evaluation of out-wintering systems based on stubble turnips for replacement heifers.
- 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<sup>1026</sup> on the performance of cereal fed beef cattle.
- 2004(c)** Evaluation of CRINA<sup>®</sup> 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 a moist co-product mix (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**

- 2016(c)** Evaluation of feeding elevated levels of milk replacer (750 v 900g) on the performance of artificially reared beef calves to 12 weeks.

- 2016(b)** Evaluation of nutritionally improved straw (NIS) in calf concentrates on the performance of beef calves to 12 weeks.
- 2015(b)** Evaluation of Sodium Butyrate on the performance and health of artificially reared beef calves to 12 weeks.
- 2014(d)** Evaluation of calf coats (Holm & Laue) on the performance and health of artificially reared beef calves to 12 weeks.
- 2014(a)** Evaluation of early weaning concentrate quality on the performance and health of artificially reared beef calves to 12 weeks.
- 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.
- 2012(e)** 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 XPLS) 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.
- 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 (750g) or low (450g) 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 XPLS 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 most of the above trial reports can be found on the National Beef Association (NBA) website (Resources>Technical Information section) and are also available from Simon Marsh (Tel: 01952 815213, E-mail: [smarsh@harper-adams.ac.uk](mailto:smarsh@harper-adams.ac.uk)).

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## Appendix 1.

### Harper Adams Beef Unit - Gross Margins - 2015/16

Stock: Sept-Oct 2014 born Continental x Holstein and Holstein bulls slaughtered Oct-Dec 2015

Financial performance (£/bull)	Holstein	Blue x Holstein
<b>Output</b>		
Sales	878	1115
Less calf purchase	48	275
<b>Total Output</b>	<b>830</b>	<b>840</b>
<b>Variable Costs</b>		
Calf rearing costs to 3 months	98	98
Finishing concentrates	367	354
Vet & medicines	8	8
Bedding & other costs	26	26
<b>Total Variable Costs</b>	<b>499</b>	<b>486</b>
<b>Gross Margin/Head</b>	<b>331</b>	<b>354</b>
<b>Physical Performance</b>		
Age at slaughter (months)	13.3	13.1
Birth wt (kg)	40	45
Slaughter wt (kg)	572	616
DLWG (kg from birth)	1.31	1.43
DLWG (kg from 12 weeks old)	1.43	1.58
Carcase wt (kg)	288	338
Daily carcass gain (kg from birth)	0.71	0.84
Killing out % <sup>1</sup>	50.5	55.0
Carcass classification	-03	R3
<b>Feeds (kg)</b>		
Milk replacer @ £1,578/t	24	24
Calf concs @ £279/t	127	127
Finishing concentrates	2,737	2,645
FCR (kg feed/kg gain)	5.43	4.90
FCR (12 weeks - slaughter)	5.92	5.28
<b>Prices</b>		
Sale price (£/kg live weight)	1.53	1.81
Sale price (£/kg carcass weight)	3.05	3.30
Finishing concs (£/t) <sup>2</sup>	134	134

#### Supplementary Information:

Bulls from 7½ months old finished on a trial to evaluate Maize Meal. See Trial Report 2016(d) for further details.

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

<sup>2</sup> From 7½ months to slaughter bulls fed *ad lib* 14% CP blend. The blend was based on 63.5% rolled barley @ £95/t, 15% soya hulls @ £119/t, 7% soyabean meal @ £247/t, 7% distillers @ 175/t, 5% molasses @ £170/t, 2.5% minerals @ £325/t plus £10/t mill & mix.

**Stock: Jan-Feb 2015 born Continental x Holstein and Holstein bulls slaughtered Feb-May 2016**

<b>Financial performance (£/bull)</b>	<b>Holstein</b>	<b>Cont x Hol</b>
<b>Output</b>		
Sales	776	1016
Less calf purchase	45	265
<b>Total Output</b>	<b>731</b>	<b>751</b>
<b>Variable Costs</b>		
Calf rearing costs to 3 months	98	98
Finishing concentrates	323	330
Vet & medicines	11	11
Bedding & other costs	26	26
<b>Total Variable Costs</b>	<b>458</b>	<b>465</b>
<b>Gross Margin/Head</b>	<b>273</b>	<b>286</b>
<b>Physical Performance</b>		
Age at slaughter (months)	13.5	14.0
Birth wt (kg)	39	44
Slaughter wt (kg)	540	592
DLWG (kg from birth)	1.22	1.28
DLWG (kg from 12 weeks old)	1.31	1.39
Carcase wt (kg)	273	323
Daily carcass gain (kg from birth)	0.61	0.70
Daily carcass gain (kg from 12 weeks)	0.68	0.79
Killing out % <sup>1</sup>	50.4	54.6
Carcass classification	O-O=/2+	O+R-/2+3-
<b>Feeds (kg)</b>		
Milk replacer @ £1,578/t	24	24
Calf concs @ £279/t	127	127
Finishing concentrates	2,411	2,462
FCR (kg feed/kg gain)	5.11	4.77
FCR (12 weeks - slaughter)	5.61	5.16
<b>Prices</b>		
Sale price (£/kg live weight)	1.44	1.72
Sale price (£/kg carcass weight)	2.82	3.14
Finishing concs (£/t) <sup>2</sup>	134	134

**Supplementary Information:**

Bulls from 6 months old finished on a trial to evaluate Nutritionally Improved Straw (NIS). See Trial Report 2016(a) for further details.

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

<sup>2</sup> From 6 months to slaughter bulls fed *ad lib* 14% CP blend. The blend was based on 63.5% rolled barley @ £95/t, 15% soya hulls @ £119/t, 7% soyabean meal @ £247/t, 7% distillers @ 175/t, 5% molasses @ £170/t, 2.5% minerals @ £325/t plus £10/t mill & mix.