Can woodchip be used as animal bedding?

Report 1

Woodchip for Livestock Bedding Project

June 2006

Lynfa Davies
HCC

FARMING connect
cyswllt FFERMIO

HYBU CIG CYMRU
MEAT PROMOTION WALES

The Woodchip for Livestock Bedding Project delivered by Hybu Cig Cymru, is match funded by the Forestry Commission, Environment Agency Wales and the Welsh Assembly Government as part of Farming Connect.

Mae'r Prosiect Sglodion Pren ar gyfer Sarnau Da Byw a gyflenwir gan Hybu Cig Cymru yn derbyn arian cyfatebol gan y Comisiwn Coedwigaeth, Asiantaeth yr Amgylchedd Cymru a Llywodraeth Cynulliad Cymru fel rhan o Cyswllt Ffermio.

INTRODUCTION

The Woodchip for Livestock Bedding Project aimed to investigate the potential use of woodchip as an alternative to straw as an indoor bedding material for livestock. Currently straw is the most popular bedding material in Wales but is estimated to cost Welsh farmers £12.5 million per year (former Agriculture and Rural Affairs Department (ARAD), 2000). Straw costs are anticipated to rise mainly due to increasing haulage costs. However, wood is a local resource and when this project commenced was readily available from forestry and wood processing enterprises. The situation has begun to change due to the dramatic rise in the demand for biofuels and hence wood that may have been available for bedding is being diverted for other uses. However, work was required to establish whether using woodchip is economically viable and, as effective as straw as a bedding material with regard to animal performance, health, welfare and cleanliness.

The project was funded through Farming Connect by Objective 1 monies, the Welsh Assembly Government, the Forestry Commission Wales and the Environment Agency Wales.

Preliminary studies using woodchip as an indoor bedding material were done at ADAS - Pwllpeiran, Llysfasi College and by the Pontbren group in Mid Wales. These studies all found woodchip to be an effective bedding material but further work was required to address the welfare aspects for the animals, the supply chain for woodchip and the potential uses for soiled woodchip after it has been used. The Woodchip for Livestock Bedding Project therefore aimed to further consolidate the previous findings and to address the additional questions that had been raised.

This report details the work carried out at three development sites (ADAS - Pwllpeiran, IGER - Aberystwyth and Glynllifon College) from January to March 2006 during the initial housing period of the woodchip project. During this initial housing period work was undertaken to address:

- Woodchip procurement, production and handling
- Woodchip performance
- Management systems
- Livestock performance

OBJECTIVES

The objectives of the initial housing period were to evaluate and demonstrate woodchip as a bedding material and to address the topics outlined below.

- Woodchip procurement, production and handling
  Wood sources
  Best chipper
  Chip moisture content
  Drying techniques

- Woodchip performance
  Comparison of wood species
  Comparison of different moisture contents
  Diet of animal

- Management systems
  Scraping feed area/ woodchip on feeding area
  Floor type
  Type of housing, enclosed/ well ventilated

- Livestock performance
  Weight gain
  Feed intakes
  Health – respiratory, foot problems
  Cleanliness
  Welfare – time spent lying on the bedding material

The three development sites concentrated on different aspects of the project.

ADAS – Pwllpeiran studied the effect of different moisture contents on the subsequent performance of the woodchip.

IGER – Aberystwyth evaluated the effect of diet on woodchip usage by comparing a hay diet with a silage diet.

Glynllifon College concentrated on the effect of wood species on the performance of the woodchip.

METHODOLOGY

The three development sites housed groups of cattle and sheep for 8 – 10 weeks on straw and woodchip according to the different parameters that they were studying. This section contains a detailed description of the specific materials and methods used at each site. Some of the methods were common across the three sites and these are outlined below.

Liveweight and condition score

Animals were weighed and conditioned scored prior to starting the housing phase and thereafter at regular intervals as specified in the methods section specific to each site.

Health and cleanliness

Throughout the housing period records of health events were kept including those not considered attributable to the woodchip. Cleanliness was measured using the Meat Hygiene Service cleanliness scoring system. All animals were scored prior to starting the housing phase and then this score was either improved on or maintained through application of bedding material during the housing period.

Labour inputs

The frequency of applying fresh bedding material and the time it took to apply the bedding was monitored to assess whether woodchip on average was more or less labour intensive than straw. Observations were also made on the practicalities of handling woodchip in comparison with straw.

Woodchip procurement

The woodchip at Pwllpeiran and IGER was sourced from Coed Frongoch sawmill, Trisant, near Aberystwyth. Chipping was done prior to delivery using a Heizohack HM8-400 drum wood chipper.

The larch, Douglas fir, Sitka spruce and beech used at Glynllifon were sourced from the college's estate. The oak and sycamore came from Wentwood Timber Centre, Caldicot, South Wales. The ash was supplied by Mynydd Timber Services and the short rotation coppice came from Forestry Research at Talybont-on-Usk. At Glynllifon, apart from the short rotation coppice which was delivered chipped, all the wood was chipped on site.

Due to problems with breakdowns several types of chipper were used. The Sitka spruce, Larch and most of the Douglas fir were chipped using a Laimet HP25 screw cone chunker. When this broke it was replaced with a Jensen 10" disc chipper, which was used for the rest of the Douglas fir, the sycamore and the oak. A small proportion of the oak for Glynllifon was sourced from Coed Frongoch in Ceredigion and was chipped using the Heizohack HM8-400 prior to delivery. The short rotation coppice was harvested 18 months prior to being required because it was sourced in advance of the funding for the project being secured. This was chipped using a Greenmech 8-10" tractor mounted disc chipper. For information on the woodchippers used see Appendix 1. At Glynllifon problems with the chippers meant that the chipping took a lot longer than planned and labour costs increased dramatically. There were also problems at Glynllifon with the wood not being the optimum size and hence, requiring a degree of preparation again, increasing labour costs.

ADAS - Pwllpeiran

The demonstration at Pwllpeiran was to investigate the effect of different moisture contents of the chip on the subsequent usage of woodchip. Two demonstrations were undertaken, running in parallel, one with pregnant ewes and the other with yearling Welsh Black cattle. In both studies three types of woodchip of different moisture contents were used alongside a straw comparison. The moisture contents aimed for were 20%, 40% and 60%. The actual moisture contents achieved were 34.4%, 52.7% and 54.9% respectively but for the purposes of this report they will be referred to as 20%, 40% and 60%.

Cattle study

Thirty two yearling Welsh Black cattle were split into 4 groups of 8 animals balanced for age, sex, weight and cleanliness. They were housed in an open-fronted shed divided into four pens. Group 1 was bedded on straw, Group 2 on 20% moisture woodchip, Group 3 on 40% moisture woodchip and Group 4 on 60% moisture woodchip.

Silage (*ad libitum*) and 2kg/head/day (dry matter basis) of concentrates were offered at a single feeding face at the front of the pen. The feeding area at the front of the pen was scraped clean on a regular basis and the slurry removed to the slurry tank.

At the start of the demonstration all pens were bedded to a depth of 100mm.

Sheep study

For the sheep study 120 twin bearing ewes in mid gestation at the start of the trial were used. The ewes were weighed and condition scored prior to being split into 4 groups of 30 animals. They were housed in a purpose built experimental sheep shed. Group 1 was bedded on straw, Group 2 on 20% moisture woodchip, Group 3 on 40% moisture woodchip and Group 4 on 60% moisture woodchip.

Silage was offered *ad libitum* from a single feeding face at the front of the pen. Concentrate feed was fed in troughs down the side of each pen. The quantity of concentrates fed was increased with standard practice for housed twin bearing ewes in late gestation.

At the start of the demonstration all pens were bedded to a depth of 100mm.

IGER – Aberystwyth

The demonstration at IGER was to study the effect of a dry hay diet against a wetter diet of silage on the performance of the woodchip bedding.

Cattle study

Twenty four 15 month old dairy heifers were allocated according to weight, body condition score and cleanliness score to one of 4 treatments. The four treatments were:

1. Straw bedding and diet of hay and minerals
2. Straw bedding and diet of silage and minerals
3. Woodchip bedding and diet of hay and minerals
4. Woodchip bedding and diet of silage and minerals

The pens were 8.8m x 4.4m with a feed barrier along the front. Each pen was equipped with drains to measure effluent production. At the start of the housing period the pens were bedded with either 1500kg of woodchip or 375kg of barley straw to achieve a depth of bedding of 125mm or 100mm respectively. Two batches of woodchip were used during the housing period, the first batch during weeks 1-5 and the second batch from weeks 6-8. Further bedding was applied as required to maintain the animals at the same cleanliness score throughout the 8 week period. The quantity of bedding used and the frequency of applications were monitored.

Feed was offered *ad libitum*, with feeding levels designed to achieve a refusal margin of 10%. Fresh silage was given 3 times a week and fresh hay was given daily.

The cattle were weighed, condition scored and scored for cleanliness at the start and end of the housing period as well as at weeks 3 and 5.

Sheep study

Sixty four 12-month old ewe lambs were allocated according to weight, condition score and cleanliness score to one of 4 treatments. The treatments were the same as for the cattle study.

The pens were 8.8m x 4.4m with a feed barrier along the front of each pen. Prior to the start of the housing period the pens were bedded with either 1500kg of woodchip or 180kg of barley straw to achieve a depth of bedding of 125mm or 50mm respectively.

Feed was offered *ad libitum*, with feeding levels designed to achieve a refusal margin of 10%. Fresh silage was given 3 times a week and fresh hay was given daily.

The sheep were weighed, condition scored and scored for cleanliness at the start and end of the housing period as well as at weeks 3 and 5.

Glynllifon College

The aim of the study at Glynllifon was to evaluate woodchip derived from different wood species. There were 8 treatments utilising different wood species as described below.

Cattle study

Forty three cattle were allocated to one of 8 pens. The number of cattle in each pen varied due to the cattle being of differing ages and weight. Due to this cattle were allocated to ensure that each pen had a similar weight ratio to floor area (Table 1). The 8 treatments were as follows:

1. Short rotation coppice
2. Oak
3. Sycamore/Beech mix
4. Larch
5. Douglas fir
6. Sitka spruce
7. Ash (also contained 20% alder)
8. Straw

Table 1. Allocation of cattle to pens at Glynllifon

Pen No.	Wood species	Cattle numbers	Area of pen (m^2)
1	SRC	3	20.3
2	Oak	3	20.3
3	Sy/Be	5	20.3
4	Larch	8	20.3
5	Doug	8	20.3
6	Sitka	6	20.3
7	Ash	7	20.3
8	Straw	3	20.3

SRC – short rotation coppice, Sitka – Sitka spruce, Doug – Douglas fir,
Sy/Be – Sycamore/Beech mix

Prior to allocation to pens the cattle were weighed, condition scored and scored for cleanliness. Cleanliness scores were recorded weekly and liveweights and condition scores were recorded fortnightly.

The cattle were fed at a feeding barrier at the front of the pen. The cattle in pens 1, 2, 3 and 8 were fed straw and concentrates *ad libitum,* as these were bull beef, and cattle in pens 4, 5, 6 and 7 were fed *ad libitum* on dry big bale silage. Pens 6 and 7 had soil-based floors whereas the rest were concrete bases.

Sheep study

Two hundred and four pregnant ewes were allocated to one of the eight treatments. The pens were of different sizes hence the numbers of animals in each pen differed (Table 2). The sheep were scored for cleanliness and condition scored prior to housing. Further condition scores were recorded at 2 weeks post housing and at lambing. Cleanliness scores were recorded weekly on a group basis and an individual cleanliness score was recorded at lambing.

Table 2. Allocation of sheep to pens at Glynllifon

Pen No.	Wood species	Sheep numbers	Area of pen (m^2)
1	Sy/Be	20	30
2	SRC	23	35.3
3	Ash	20	30
4	Doug	20	30
5	Oak	23	35.3
6	Straw	16	24
7	Larch	41	54
8	Sitka	41	54

SRC – short rotation coppice, Sitka – Sitka spruce, Doug – Douglas fir,
Sy/Be – Sycamore/Beech mix

All the sheep were fed hay. Pens 7 and 8 were fed from hay racks running along the back of the shed whereas the remaining pens had walk through feed troughs. Consequently pens 2 and 5 had access to hay on both sides of their pens.

RESULTS

1. ADAS – Pwllpeiran

Quantities of bedding used

The quantities of bedding used for the cattle and sheep studies are given in Table 3 together with the frequency of applications and the total weight of chip and manure at the end of the housing period available for composting.

Table 3. Quantities of bedding material used for cattle and sheep studies at Pwllpeiran.

	Total Weight of chip material	Total weight of chip & manure	Number of applications	Mean interval between applications	Mean depth of bedding at clean out
Cattle					
Straw	1510 kg	7670 kg	8	7 days	25.3 cm
60%	5770 kg	11780 kg	14	4 days	31.9 cm
40%	5540 kg	11040 kg	14	4 days	34.2 cm
20%	4330 kg	10230 kg	14	4 days	31.2 cm
Sheep					
Straw	660 kg	3700 kg	14	4.0 days	22.3 cm
60%	5180 kg	7780 kg	16	3.4 days	38.0 cm
40%	4720 kg	7540 kg	16	3.4 days	37.3 cm
20%	3545 kg	5540 kg	15	3.6 days	43.0 cm

On a weight (kg) basis considerably more woodchip was used compared with straw for both cattle and sheep. The bedding was applied to maintain the cleanliness of the animals. Applications of woodchip were required more frequently than the straw, once a week for straw and on average twice a week for woodchip.

Labour

It was estimated that woodchip took approximately 5 minutes longer to apply than straw because it required manual spreading with a pitchfork.

Animal performance

The cattle were weighed and condition scored at the start of the demonstration and then fortnightly after that (Table 4). All groups had small daily liveweight gains apart from those bedded on the 20% moisture content woodchips. These animals experienced a daily weight loss of 110g.

Table 4. Physical performance of cattle bedded on either straw or woodchips of different moisture content at Pwllpeiran.

	Straw	20% Moisture	40% Moisture	60% Moisture
Liveweight (kg)				
Week 0	393.7	399.7	402.3	401.7
Week 2	386.3	379.5	389.3	401.7
Week 4	379.5	380.5	392.3	399.8
Week 6	389.8	388.8	399.5	395.5
Week 8	395.7	393.3	405.3	414.0
Liveweight change (kg)				
Total	**2.00**	**-6.40**	**3.00**	**12.3**
Daily	**0.04**	**-0.11**	**0.05**	**0.22**
Condition Score				
Week 0	2.88	2.63	2.96	2.75
Week 2	3.13	2.88	2.75	2.46
Week 4	2.42	2.17	2.33	2.13
Week 6	2.42	2.63	2.54	2.46
Week 8	2.63	2.63	2.67	2.67

The ewes were conditioned scored at the start of the housing period and there after at fortnightly intervals. Over the 8-week period the change in ewe body condition score was less than a quarter of a score for all of the treatments (Table 5).

Table 5. Body condition scores of pregnant sheep bedded on either straw or woodchips of different moisture content at Pwllpeiran.

	Straw	20% Moisture	40% Moisture	60% Moisture
Week 0	3.33	3.36	3.37	3.43
Week 2	3.68	3.67	3.51	3.73
Week 4	3.73	3.78	3.80	3.77
Week 6	3.65	3.60	3.61	3.63
Week 8	3.50	3.35	3.48	3.42

Feed intakes

Intakes were calculated on a pen basis and only for silage. The dry matter of the silage fed to the cattle was 26.7% and the dry matter of the silage fed to the sheep was 20.4%. Both the cattle and sheep received concentrates. The cattle were fed a commercial pellet at 2kg per head per day and the sheep were fed a commercial concentrate at a stepped rate per head per day in line with stage of pregnancy. Daily dry matter intakes are shown in Table 6.

Table 6. Silage dry matter intakes (kg) per pen for cattle and sheep bedded on straw or woodchips of different moisture content at Pwllpeiran.

	Straw	20% Moisture	40% Moisture	60% Moisture
Cattle	36.0	40.8	36.0	38.4
per animal	4.5	5.1	4.5	4.8
Sheep	16.9	16.1	16.8	16.8
per animal	0.48	0.46	0.48	0.48

Animal health and cleanliness

The sheep were scored at 1 on the Meat Hygiene Services cleanliness scoring system at the start of the housing period and were maintained at this on all the treatments throughout the 8 week period.

The results for the cattle are summarised in Table 7. The cattle on the straw, 20% moisture woodchips and 40% moisture woodchips had a cleaner score at the end of the housing period compared to the beginning. The cattle on the 60% moisture woodchips were slightly dirtier at the end of the housing period compared with the beginning.

Table 7. Average cleanliness scores for cattle bedded on either straw or woodchips of different moisture content at Pwllpeiran.

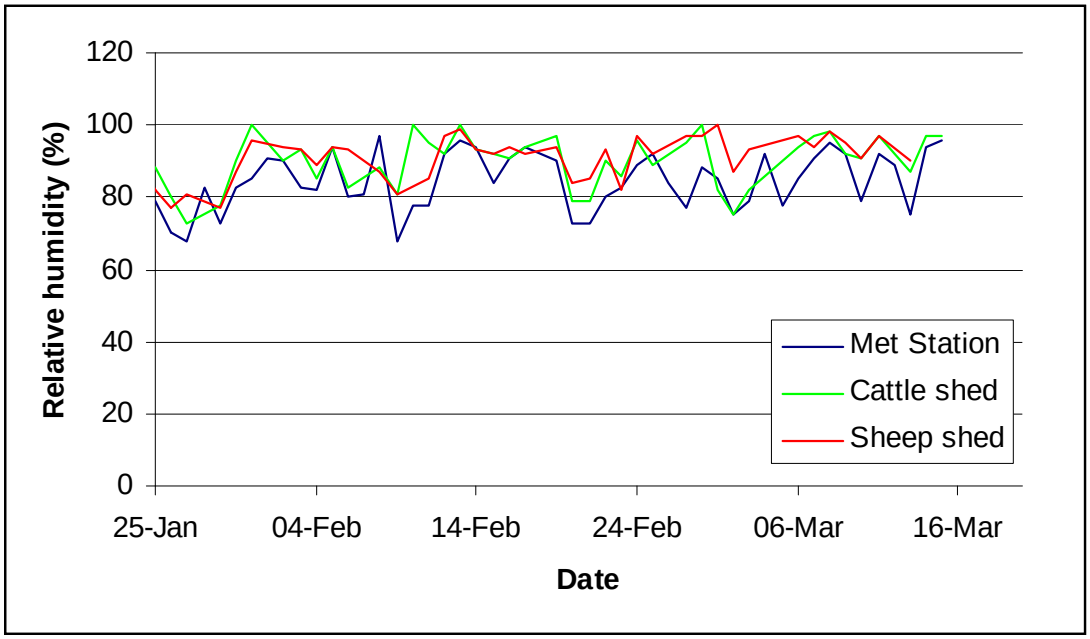
	Straw	20% Moisture	40% Moisture	60% Moisture
Week 0	3.00	2.67	3.00	2.67
Week 2	2.92	2.50	2.92	2.67
Week 4	2.67	2.33	2.75	2.83
Week 6	2.67	2.33	2.67	2.67
Week 8	2.83	2.17	2.67	2.75

No health problems were observed for the cattle during the study. Foot problems were experienced by some sheep but these were common to all 4 treatments and were not outside the usual problems associated with housed sheep. To try and eradicate these problems the sheep were walked through a footbath every fortnight and the front of their pens were treated with lime. Two sheep required calcium injections, one sheep experienced a prolapsed uterus and one died from listeria poisoning. None of these conditions were attributed to the bedding material.

Weather

Relative humidity levels in the cattle and sheep sheds was monitored and compared with the meteorological data collected from the weather station at Pwllpeiran. The results are shown in Figure 1.

Figure 1. Relative humidities in animal housing compared to local weather station at Pwllpeiran.



The results show that the relative humidity was higher in the animal sheds but the pattern was the same as the meteorological data.

2. IGER – Aberystwyth

Quantities of bedding used

The dry matter of the woodchip and straw was determined and is shown in Table 8.

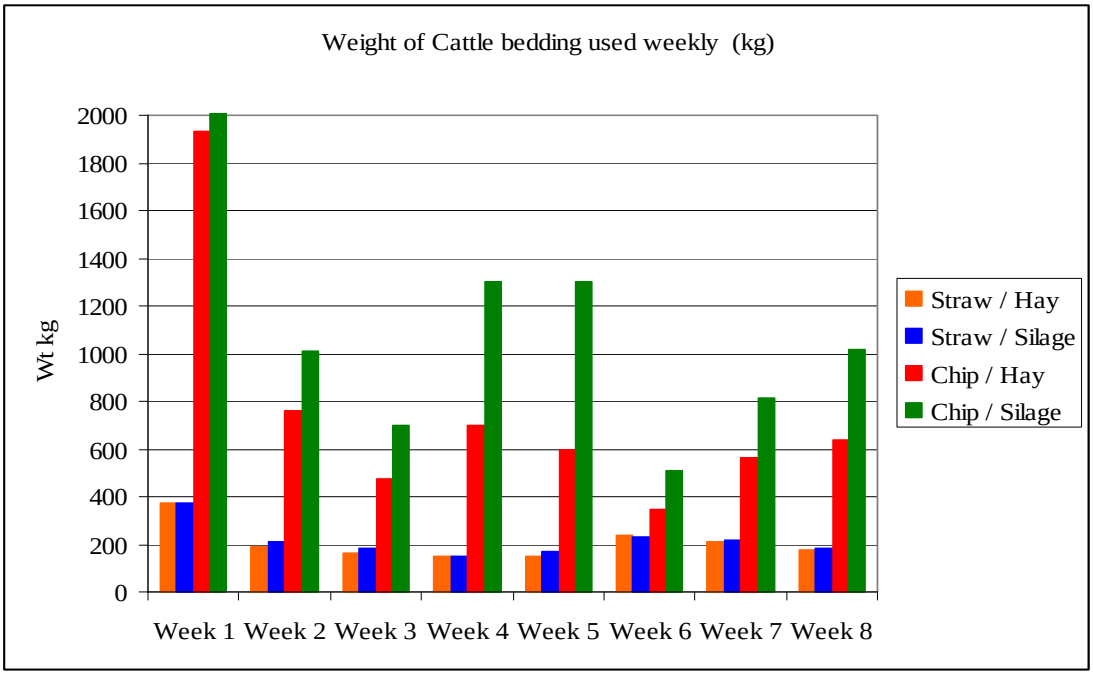
Table 8. Dry matter of bedding material at IGER

		Mean DM %
Wood chip	First delivery *	47.2
	Second delivery *	54.2
Straw		86.5

*The first delivery of wood chip was used during weeks 1-5 of the trial and the second delivery of wood chip was used during weeks 6-8 of the trial

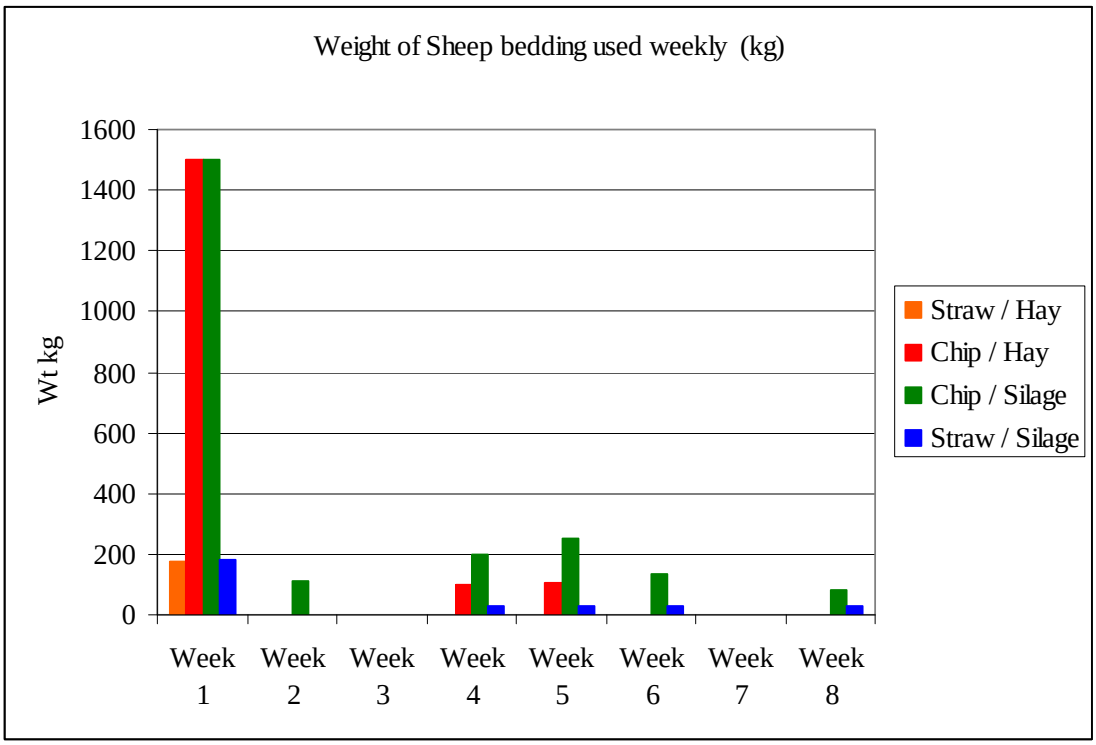
The cattle offered hay used less bedding than the cattle offered silage, most likely due to the differences in the dry matter content of these forages (Figure 2). Overall, when woodchip was used as bedding the cattle offered silage used approx 50% more bedding than the hay fed cattle but when straw was used, the amount of bedding used was the same whether cattle were offered silage or hay.

Figure 2. Weight of cattle bedding used at IGER.



The pen with sheep that was bedded on straw and fed hay did not require any further bedding for the duration of the housing period. The pen with sheep bedded on woodchip and fed hay only had 2 top-up applications of bedding, which occurred during weeks 4 and 5 of the housing period. The sheep fed silage needed more frequent applications of bedding (Figure 3).

Figure 3. Weight of sheep bedding used at IGER.



Labour

For the cattle, the woodchip treatment pens were bedded down twice weekly compared to the straw treatment pens only requiring fresh bedding once a week. Bedding applications were required far less for the sheep on the hay diet compared to the sheep on the silage diet (Figure 3).

Animal performance

For the cattle the improvements in liveweight gain and condition score were as a result of diet as shown in Figures 4 and 5. The cattle being fed silage had better liveweight gains and their condition scores increased compared with the cattle fed hay. The bedding material was not considered to have an effect on the animal performance.

Figure 4. Liveweight gains of cattle at IGER.

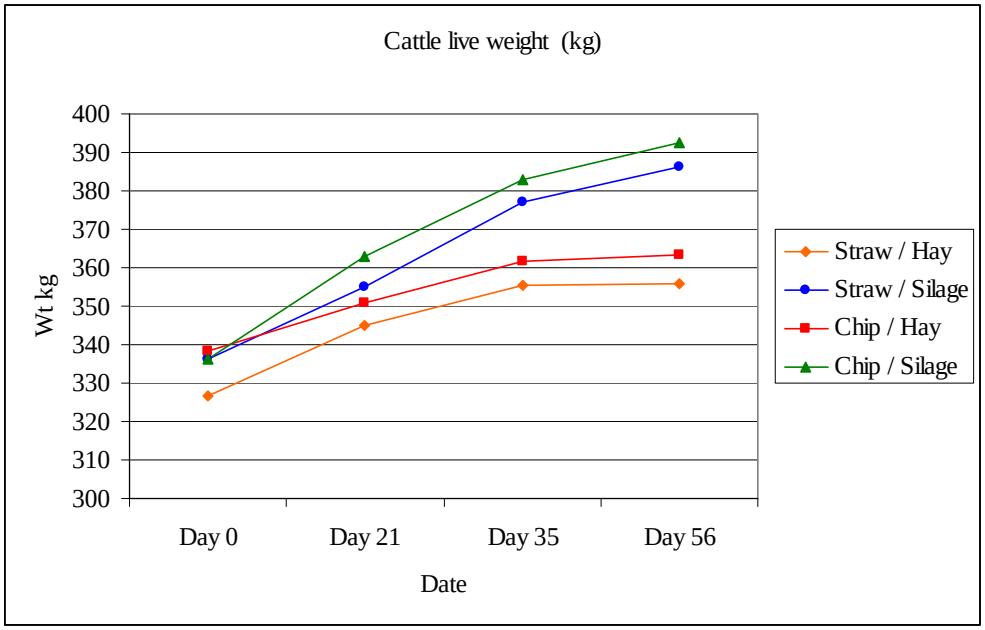
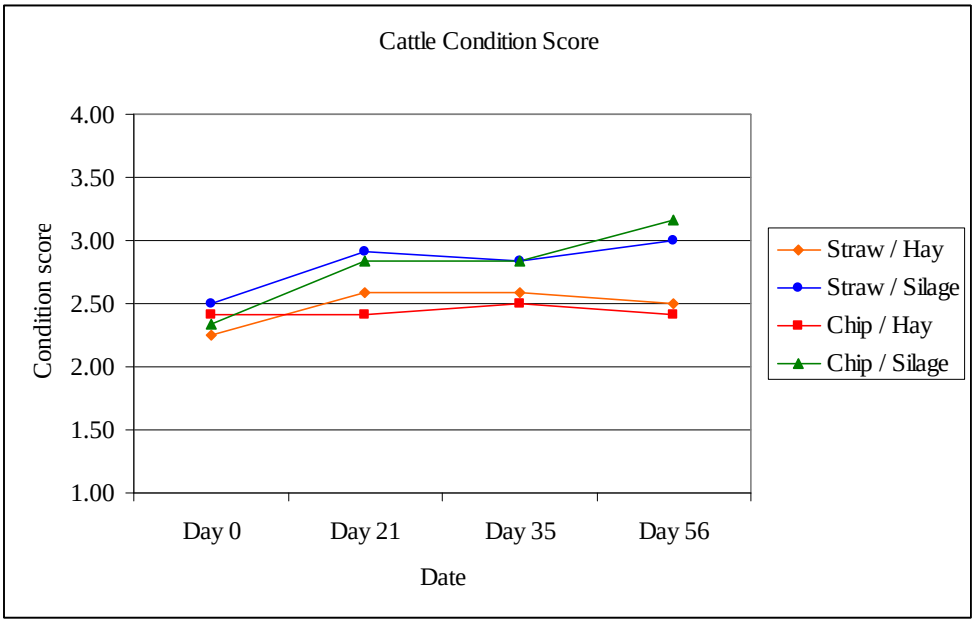
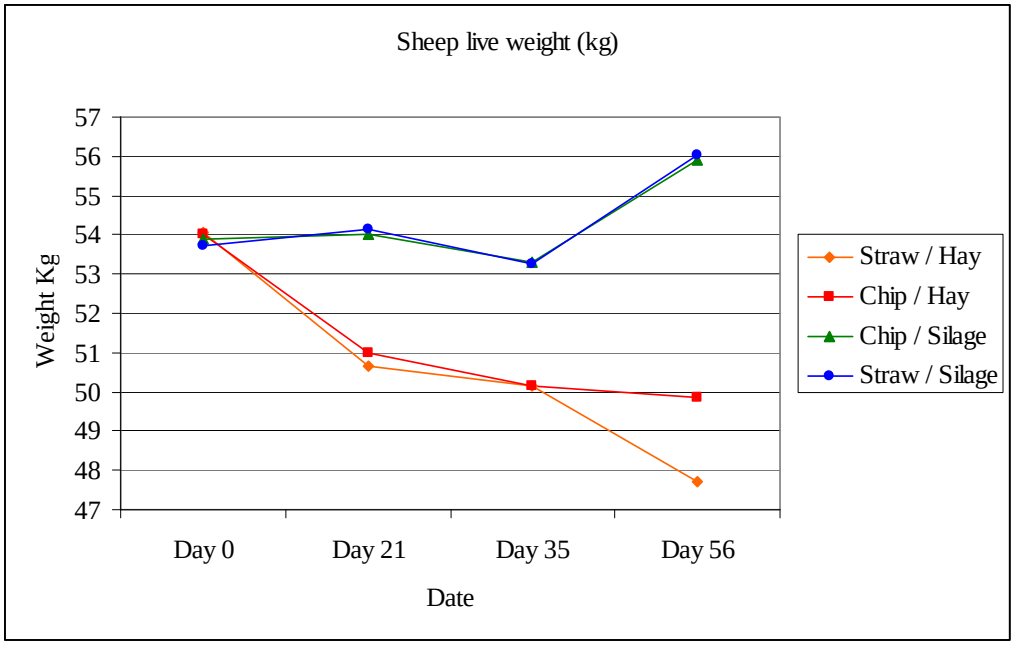


Figure 5. Condition scores of cattle at IGER.



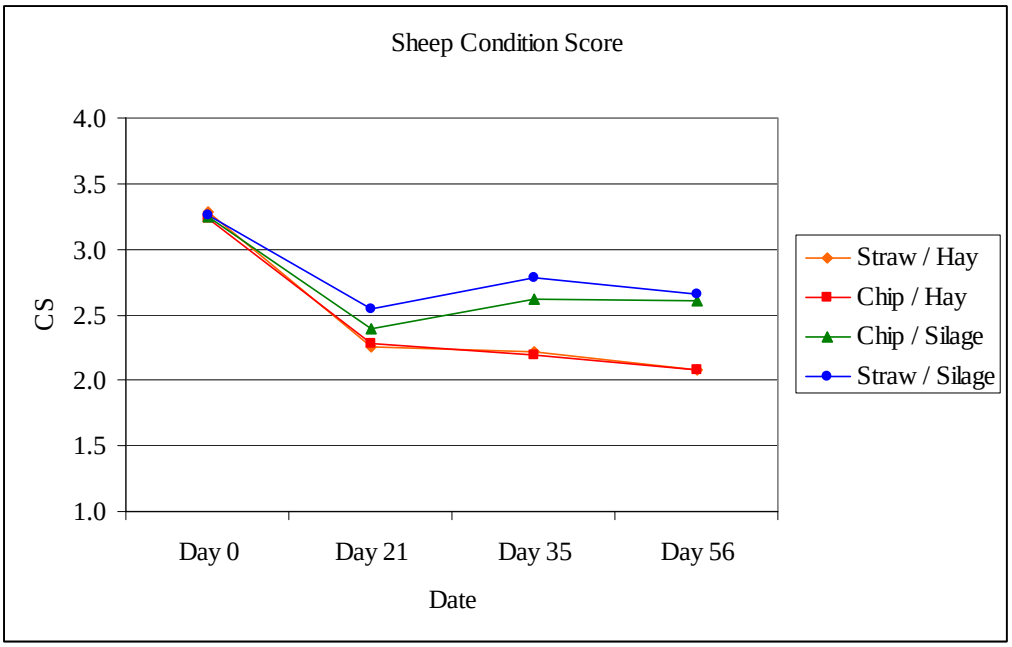
During the housing period the sheep fed silage gained, on average, 2kg of liveweight whereas the sheep fed hay lost weight. These changes in liveweight were not considered to be due to the bedding material but entirely due to the diet.

Figure 6. Liveweight change of sheep at IGER



All the sheep lost condition during the housing period, even those that gained weight. The sheep on the hay diet had a lower condition score than the sheep fed silage. Again, the type of bedding was not considered to affect the body condition score.

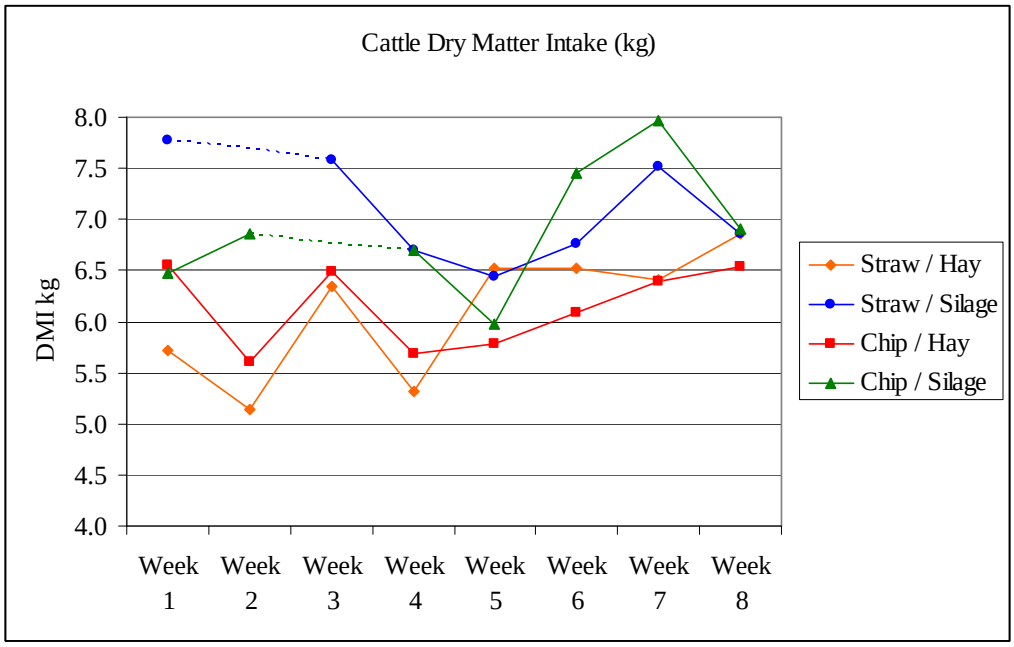
Figure 7. Condition scores of sheep at IGER



Feed intakes

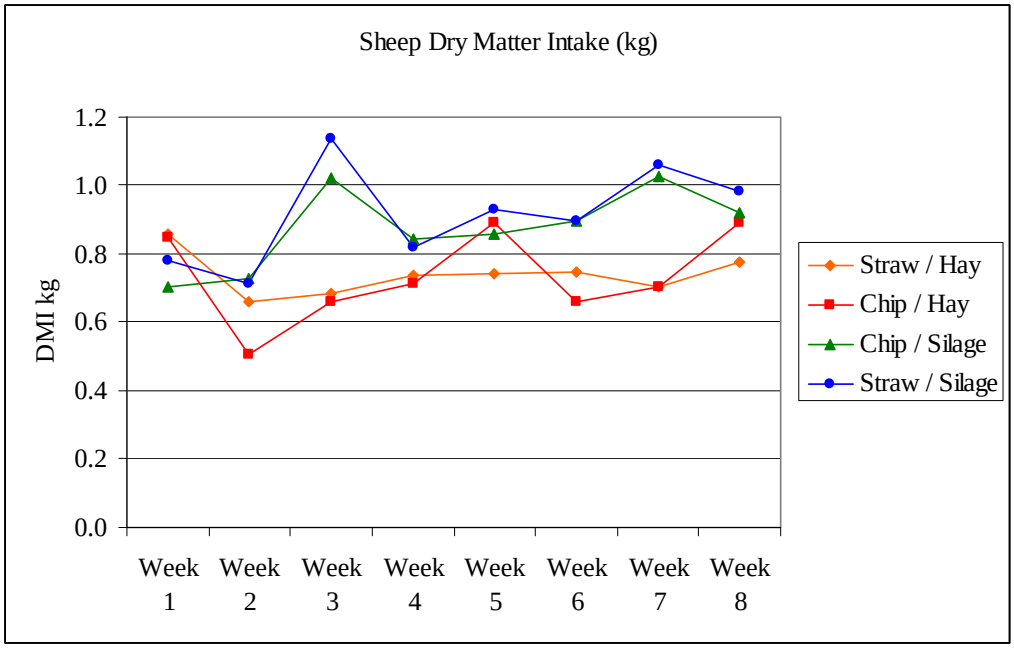
The data shows that the dry matter intakes of the cattle were very variable (Figure 8). Overall, it was better for those being fed silage compared to those on the hay diet. The differences in dry matter intake were not considered to be due to the bedding material.

Figure 8. Dry matter intakes of cattle at IGER



The dry matter intakes of the sheep were also variable but not to the extent that the cattle were. The ewes on the silage diet had higher intakes than those on the hay diet but the bedding material did not influence this.

Figure 9. Dry matter intakes of sheep at IGER



The dry matter content of the forages offered are shown in Table 9.

Table 9. Dry matter of feed offered to sheep and cattle at IGER

	Mean DM%
Hay	82.7
Silage	29.6

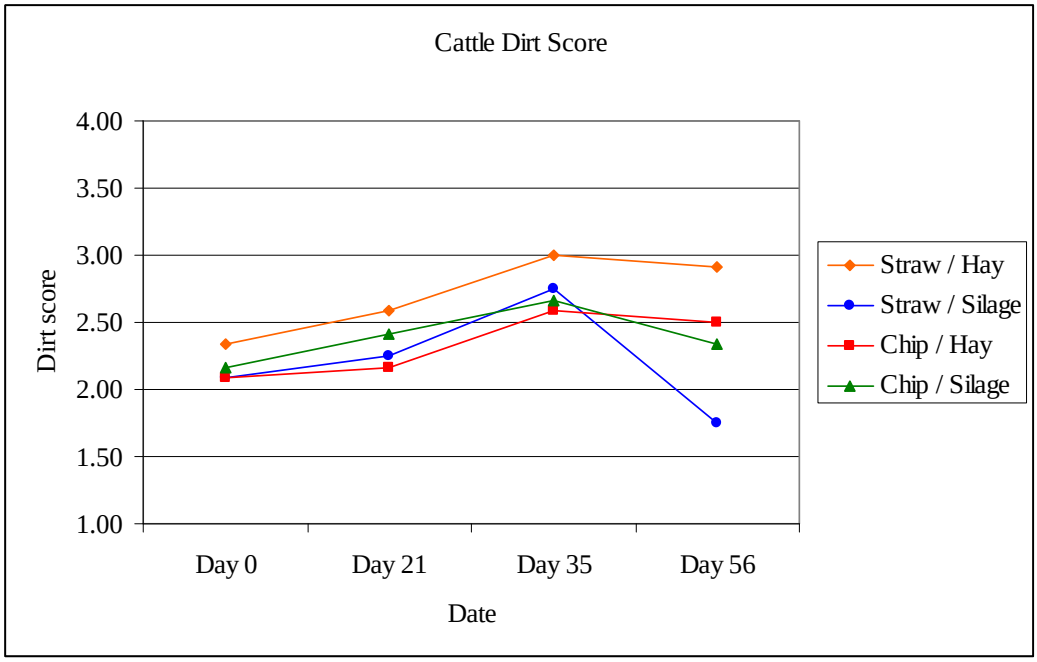
Animal health and cleanliness

No health problems were encountered during the housing period with the cattle.

Three sheep were treated from the woodchip/silage treatment pen for lameness. All 3 had woodchips lodged between their hooves.

Apart from the cattle on straw being fed silage, all the cattle had slightly worse cleanliness scores at the end of the demonstration compared to the beginning. The cattle on straw being fed silage improved their cleanliness score over the 8 weeks (Figure 10). Cattle cleanliness scores followed similar patterns for all treatments during the first 5 weeks of the housing period with cattle gaining approximately ¾ of a cleanliness score. The dirtiness of the cattle was found to be very dynamic – as old dirt clags dropped off so new ones developed. The cattle bedded on straw and being fed a hay diet were found to have the worst cleanliness score. This was thought to be due to the faeces from the cattle on this diet being much drier. It then tended to stick to the animal's feet as they walked from the dirty feeding area to the cleaner lying area.

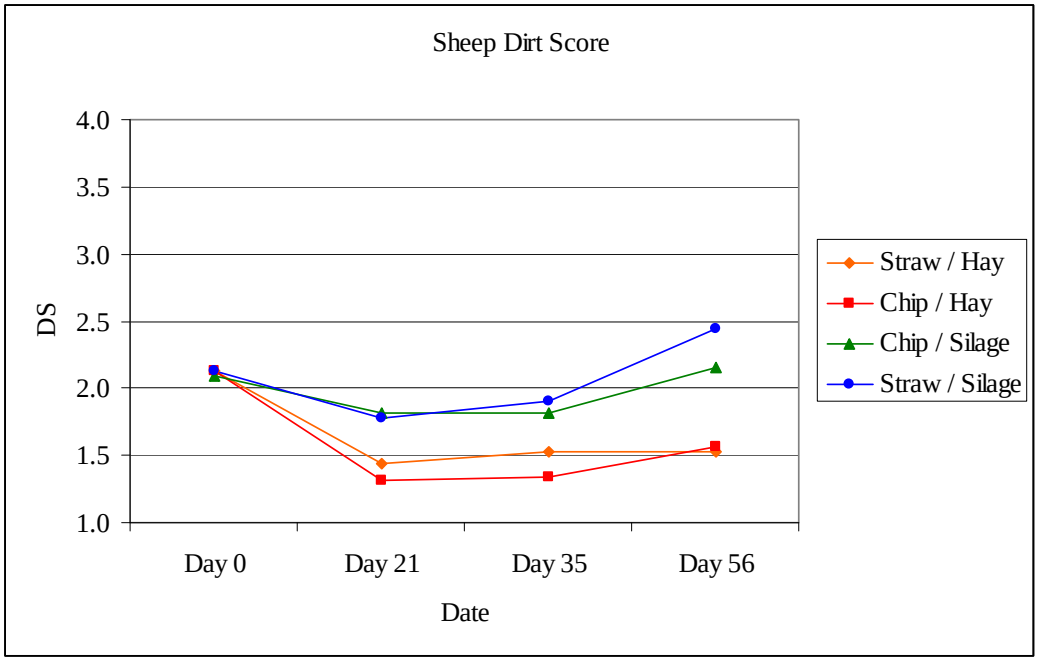
Figure 10. Cleanliness scores of cattle at IGER



The sheep on the hay diet had lower cleanliness scores than the sheep that were being fed silage. The sheep on the hay diet dragged hay onto the bedding, which inadvertently helped to keep them cleaner. Attempts were made to rectify this problem by scraping the top surface of the pens but it proved very difficult to remove the hay.

It was also observed that the sheep bedded on woodchip were cleaner than the cattle on woodchip. This was thought to be due to the sheep mixing the dung into the chip as they ran around the pen.

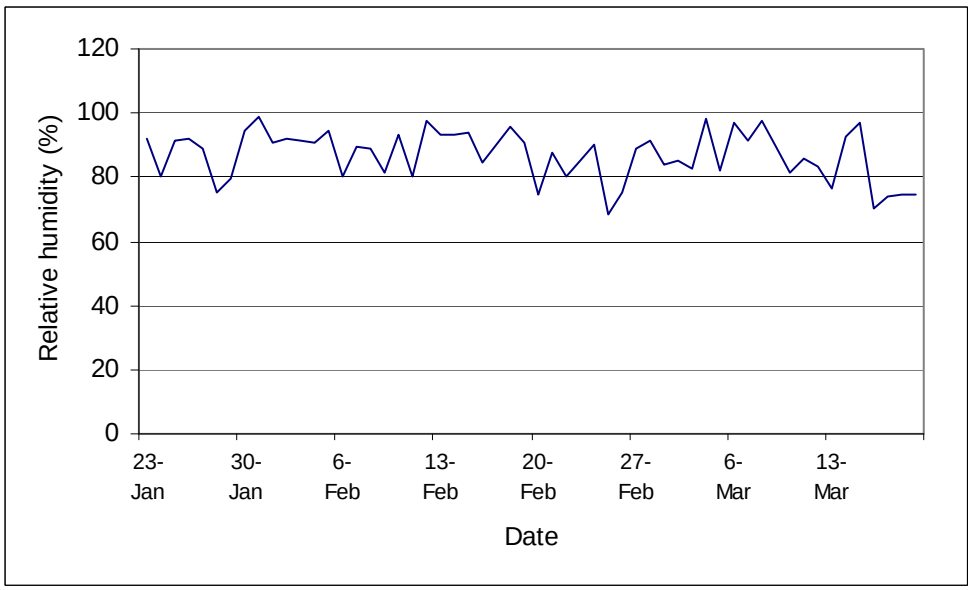
Figure 11. Cleanliness scores of sheep at IGER



Weather

The relative humidity data was collected from the meteorological station at Aberystwyth and the results are shown in Figure 12.

Figure 12. Relative humidity data from IGER



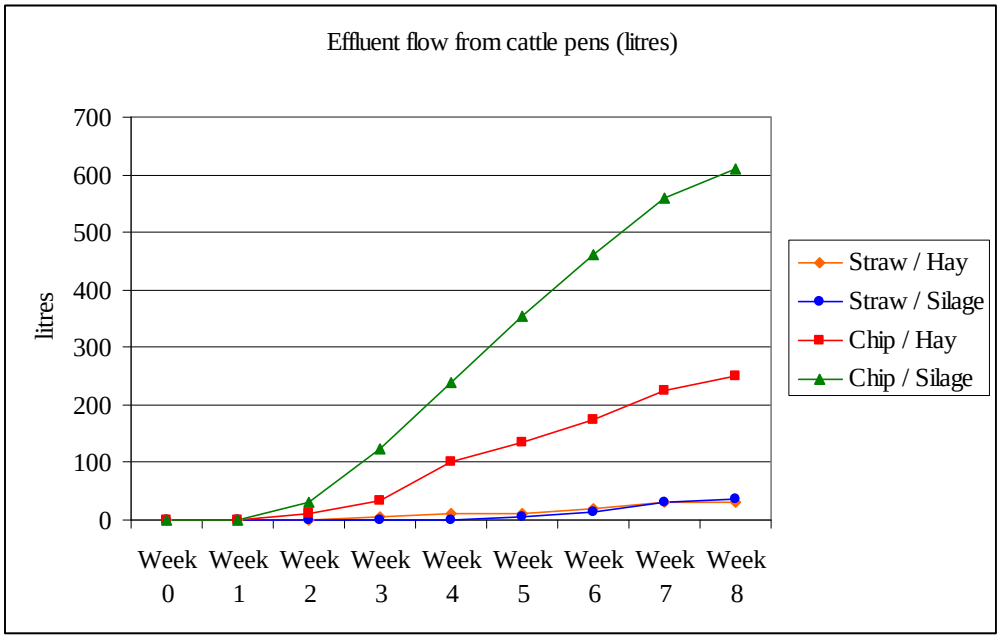
Effluent production

For the cattle, effluent production from both straw treatments was low for the duration of the housing period with approximately 35 litres produced from each (Figure 13). However the effluent flow from the woodchip pens was considerably greater. The

woodchip/hay treatment produced 250 litres of effluent and the woodchip/silage treatment produced 600 litres of effluent.

Effluent production from the sheep was very low and therefore not recorded.

Figure 13. Effluent production from cattle pens at IGER



3. Glynllifon College

Quantities of bedding used

Initially a 100mm layer of woodchip was applied to each of the woodchip pens. Depth of straw was applied as per normal procedures at Glynllifon. Further fresh bedding was added to the sheep and cattle pens on a weekly basis. The average dry matters of the woodchip are shown in Table 10 and the quantities used are shown in Table 11.

Table 10. Average dry matters (%) of woodchip at Glynllifon.

Species of wood	Dry Matter %
SRC	59.35 (n=4)
Oak	61.60 (n=4)
Sitka Spruce	64.77 (n=4)
Ash	66.80 (n=3)
Douglas Fir	67.90 (n=4)
Sycamore/Beech mix	68.90 (n=4)
Larch	74.25 (n=4)

SRC – short rotation coppice

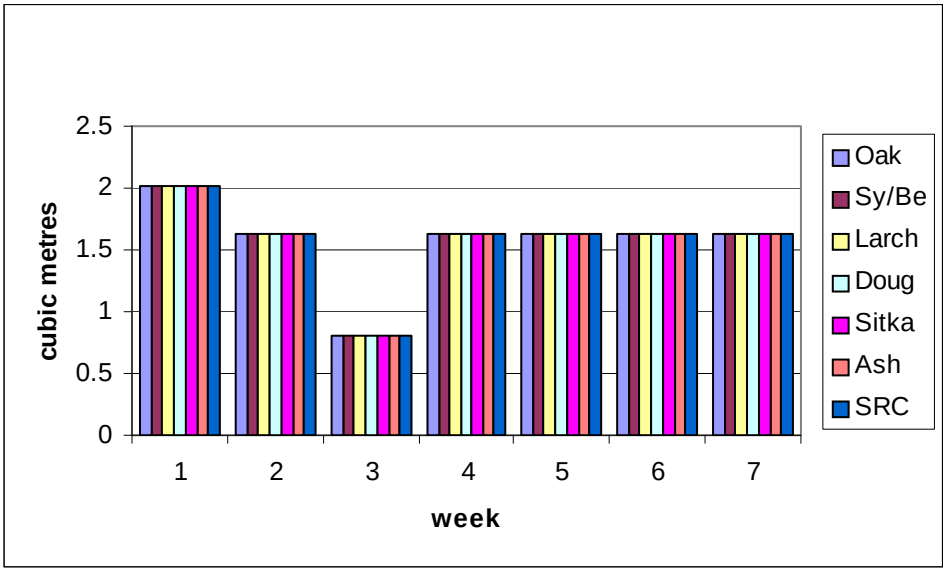
Table 11. Total quantity of straw and woodchip used in the sheep and cattle pens at Glynllifon.

	Straw (kg)	**Woodchip** (m^3)						
		SRC	Oak	Sitka	Ash	Doug	Sy/Be	Larch
Cattle	777	10.99	10.99	10.99	10.99	10.99	10.99	10.99
Sheep	130	8.04	7.67	10.15	7.44	7.44	7.22	10.15

SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir,
Sy/Be – Sycamore/Beech mix

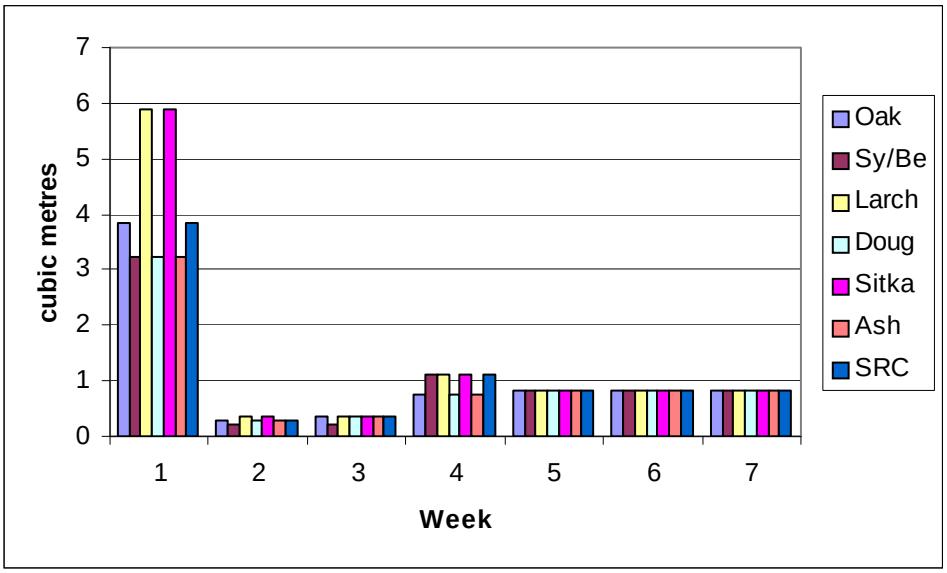
For the cattle the same quantity of straw was applied each week (111kg) but for the sheep after the initial bedding of 55kg of straw further applications of 15kg were required in weeks 3, 5, 6, 7 and 8. Quantities of woodchip used for the cattle and sheep are shown in Figures 14 and 15.

Figure 14. Quantity of woodchip applied to cattle pens at Glynllifon.



SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir,
Sy/Be – Sycamore/Beech mix

Figure 15. Quantity of bedding applied to sheep pens at Glynllifon.



SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir,
Sy/Be – Sycamore/Beech mix

Labour

At Glynllifon the woodchip created a large demand on labour at all stages, from chipping, bagging up for transporting to pens and applying to the pens. At the point of chipping the wood was transported to the chipper and in many cases was reduced in size to feed into the chipper. For the system adopted at Glynllifon the woodchip was transferred to dumpy bags prior to transporting to the pens. It was estimated that for the 8 – 10 week housing period it took 3 farm staff a total of 40 hours to transport bedding to the sheep and apply it to the pens. For the cattle it took 3 farm staff a total of 55 hours to transport the woodchip to the pens and apply it. In previous years similar quantities of cattle over a corresponding period took 15 hours to apply bedding to and for sheep it took 10 hours.

Some difficulty was encountered in applying clean woodchip to the sheep pens because the sheep thought they were being fed and would rush forward. This caused concern because the ewes were heavy in lamb. Therefore, the sheep were moved out of the pens while the woodchip was applied.

The volume of woodchip and the physical application also proved a problem. Initially the woodchip was placed in small 50kg bags and carried to the pens but this method was very inefficient. The method was changed to transporting the woodchip in dumpy bags using the bobcat machine. This system was used for the cattle from the outset.

The cattle were given fresh bedding on a weekly basis while the sheep bedding was replenished twice weekly or as required.

Animal performance

Average daily liveweight gains of the cattle for the 8 week housing period are shown in Table 12.

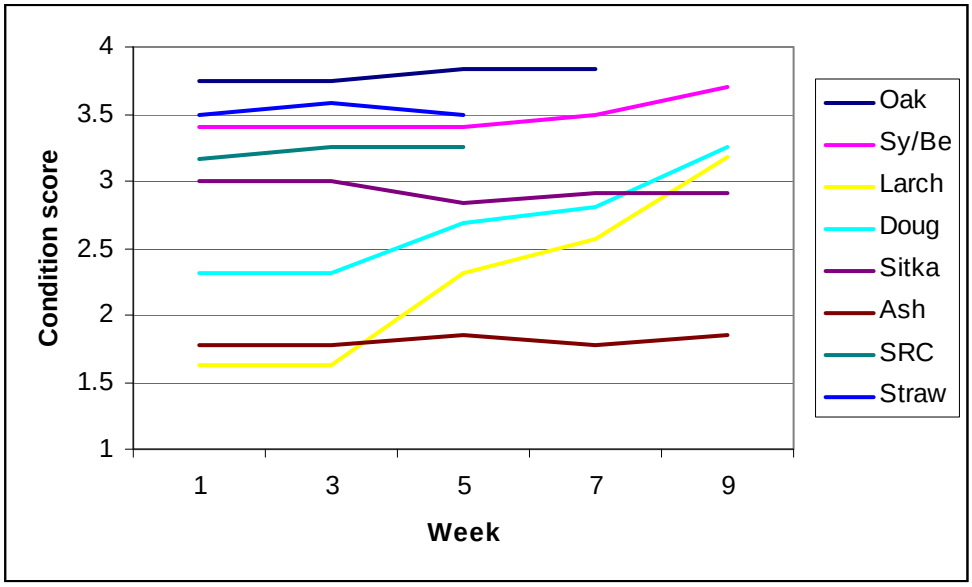
Table 12. Cattle daily liveweight gains at Glynllifon

Group and bedding type		No of animals (sex)	Age at start of trial (months)	Av DLWG (KG)
1	SRC	3 (M)	16	1.08
2	Oak	3 (M)	18	1.08
3	Sy/Be	5 (4M, 1F)	12	1.13
4	Larch	8 (M)	8	1.41
5	Doug	8 (5M, 3F)	11	0.69
6	Sitka	6 (1M, 5F)	14	0.43
7	Ash	7 (1M, 6F)	11	0.62
8	Straw	3 (M)	14	1.02

SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir,
Sy/Be – Sycamore/Beech mix
DLWG – Daily liveweight gain

The condition scores of the cattle either remained constant or improved slightly over the housing period (Figure 16).

Figure 16. Condition scores of cattle at Glynllifon.



SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir, Sy/Be – Sycamore/Beech mix
Animals from straw and SRC pens were sold after week 5.

The ewes were condition scored at housing, 2 weeks post housing and then at lambing (week 6). All condition scores remained constant or showed a slight improvement between the first and second condition score. This was due to the ewes receiving an increase in concentrates of 0.2kg per day at this time. The condition scores then remained constant through to lambing.

Table 13. No of animals in each pen and condition score of ewes at Glynllifon

Group and bedding type		No of animals	Average condition score		
			Week 1	Week 3	Week 6
1	Sy/Be	20	2.5	2.5	2.5
2	SRC	23	2.5	3	3
3	Ash	20	2.5	2.5	2.5
4	Doug	20	2.5	2.5	2.5
5	Oak	23	2.5	3	3
6	Straw	16	2.5	3	3
7	Larch	41	2	2.5	2.5
8	Sitka	41	2.5	3	3

SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir, Sy/Be – Sycamore/Beech mix
Condition scores are an average of the group

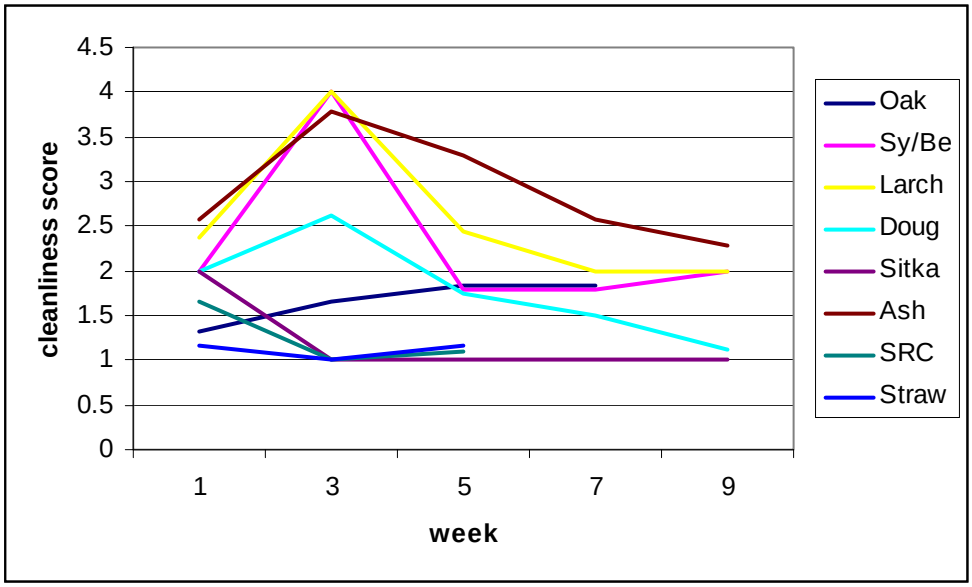
Animal health and cleanliness

No health issues were recorded with the cattle. The cattle's final cleanliness score was similar to the one at the beginning (Figure 17). Prior to housing the cattle were clipped to attain standardisation. However, for some pens there was a period when cleanliness was not maintained at ideal levels.

The Ash woodchip appeared the dirtiest throughout the demonstration in comparison to the Sitka woodchip, which remained very clean. It is worth noting that these two pens had similar stocking levels and both had soil bases.

The pen with cattle bedded on Larch woodchip was the only pen that had effluent seepage from the bed into the cattle standing area.

Figure 17. Average cleanliness scores of cattle at Glynllifon.



SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir, Sy/Be – Sycamore/Beech mix

It was observed that the sheep took a little longer to acclimatise to the woodchip and for the first few days they appeared a little uneasy and stood for longer periods of time. However, this situation improved after just one week.

The cleanliness scores of the ewes stayed very constant with all bedding types achieving very good scores. The ewes were scored as a pen from weeks 1 – 5 but were given individual scores at lambing. These individual scores have been amalgamated and averaged for week 6 in the table below.

Table 14. Average cleanliness scores of ewes at Glynllifon.

Week	Bedding type							
	Oak	Sy/Be	Larch	Doug	Sitka	Ash	SRC	Straw
2	2	1	1	2	1	2	2	1
3	2	1	1	2	1	2	2	1
4	2	1	1	2	1	2	1	1
5	2	1	1	2	1	2	1	1
6	2	1	1	2	1	2	2	1

SRC – short rotation coppice, Sitka – Sitka Spruce, Doug – Douglas Fir, Sy/Be – Sycamore/Beech mix

The SRC woodchip contained a high proportion of fine material, which tended to stick in the belly wool of the sheep. The cattle were not affected in this way and remained relatively clean on it. Visual observations again showed the Ash woodchip to be dirtier than the other types of woodchip despite having a similar dry matter to the other woodchips.

It was noted that as lambing progressed and ewes were removed from the pens, the pens appeared cleaner and drier. No health issues arose while lambing the ewes on the woodchip and the sheep remained content throughout.

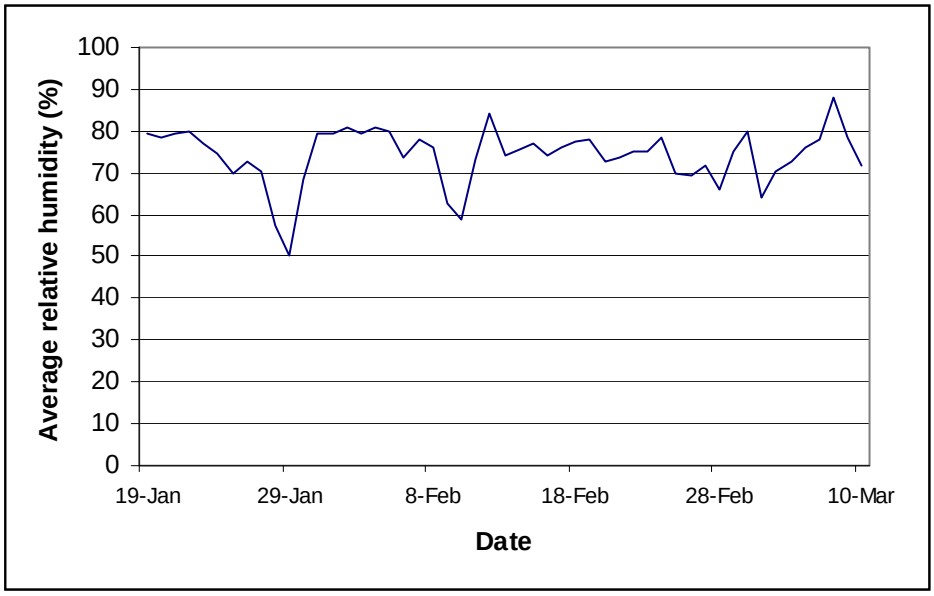
Six ewes were suffering from minor lameness at the beginning of the housing period. This lameness did not get any worse and no new cases were reported. It was observed that for the sheep on the woodchip the feet were dry and free from scalding and had no unpleasant odours. The sheep on the straw, however, were observed to have softer hooves with slight evidence of scalding. The straw also had a tendency to wrap around the feet.

Some ewes developed pregnancy toxaemia but these ewes were not confined to one treatment. The bedding material was not considered to be responsible for this.

Weather

Rainfall was low until 12th February as indicated by the low humidity (Figure 18). The animals and pens appeared much cleaner during this time in comparison to the second half of February when humidity levels (and rainfall) was higher. During the wetter periods the animals did appear to get dirtier but this soon dried and rubbed off them.

Figure 18. Average relative humidity (%) at Glynllifon.



Data from University of Wales, Bangor

CONCLUSIONS

ADAS – Pwllpeiran

Quantities of bedding used and labour

Pens bedded with woodchip required more frequent topping up compared with the straw. There were no problems associated with handling the woodchips but it did take slightly longer to bed the pens with woodchip compared with straw. However, this was only recorded as being 5 minutes longer.

Animal performance and health

The performance and health of the sheep was satisfactory during the housing period. The health of the cattle was also satisfactory but the performance was disappointing. This was due to the diet being a high dry matter mature grass silage and the poor performance was not considered to be related to the bedding material.

Impact of moisture content of woodchip

The moisture content of the 40% and 60% moisture woodchips was actually 52.7% and 54.9% respectively. This accounts for small differences in the quantity of 40% moisture woodchip compared to 60% moisture woodchip for both the sheep and cattle. However, the quantity of 20% woodchip used for both sheep and cattle is considerably less than for the 40% and 60% moisture woodchip. This illustrates that moisture content does have an effect on the amount of bedding required and this is most likely due to the effect on absorbency of the woodchip. On a weight for weight basis far less straw was used than woodchip for both sheep and cattle. The 20% moisture woodchip was actually 34.4% moisture content. However, had a moisture content similar to straw (20%) been achieved it is still likely that a greater quantity of woodchip would have been required in comparison to the straw. This is due to the physical nature of the two bedding materials and consideration should be given as to whether they can be compared on a weight basis.

IGER – Aberystwyth

Quantities of bedding used and labour

Animals fed hay used far less woodchip than the animals fed silage, thus indicating that the dry matter of the feed affects bedding usage. On a weight basis less straw was used for all pens regardless of diet in comparison to the quantity of woodchip used. However, the woodchip used did have very high moisture content and therefore a reduced absorbency.

Animal performance and health

All changes in liveweight were directly attributable to the diet and the bedding material played no part in the performance of the animals.

The health of the animals was satisfactory during the housing period and the cattle, in particular, experienced no health problems. Three ewe lambs became lame as a result of woodchips becoming lodged in their hooves. Consideration should be given to the shape of the woodchip to eliminate such problems.

Impact of diet on performance of woodchip

The dry matter content of the diet did have an effect on the quantities of bedding used particularly with the cattle. However, it must be remembered that the moisture content of the woodchip was approximately twice that of the straw and therefore not a fair comparison. Despite this the woodchip performed well as a bedding material with the animals maintaining their cleanliness score and remaining healthy.

Glynllifon College

Quantities of bedding used and labour

The same amount of woodchip was used for all wood species, which would be expected, as the dry matters were very similar.

Estimated labour was considerably higher for the woodchip with the current systems employed at Glynllifon.

Animal performance and health

None of the animals experienced health or welfare problems that could be attributed to the woodchip. Despite some concerns about lambing the ewes on the woodchip no problems were experienced. As ewes lambed and stocking densities reduced in the pens, the pens appeared cleaner. This suggests that sheep may benefit from lower stocking densities while on woodchip. However, the cleanliness scores of the sheep do not indicate a problem with the stocking densities.

Impact of wood species on performance of woodchip

It would appear that the dry matter of the woodchip is far more influential than the species of the wood in terms of quantities used. Based on visual observations staff at Glynllifon suggested that the animals on the Ash woodchip were harder to keep clean. The cleanliness scores in Table 14 and Figure 16 show that for the ewes the Ash was no worse than the Oak or the Douglas Fir but with the cattle the Ash woodchip was consistently dirtier. The SRC woodchip was found to have a high proportion of fine particles and this tended to contaminate the fleeces of the sheep.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

- Health and welfare of animals. Overall the health and welfare of the animals was very good and was not affected by the use of woodchip as bedding. No respiratory problems were experienced with any of the sheep or cattle. A few of the ewe lambs at IGER became lame due to the chips lodging between the hooves. Ensuring the chip shape is square and chunky rather than sharp and pointy could rectify this problem. This is down to chipper selection. Personal communication with staff at the development sites revealed that there was a period of adaptation time involved when animals were first housed on the woodchip. This was more pronounced with sheep. For the first couple of days the sheep appeared unsettled and not as relaxed as the sheep on straw. After a few days the sheep became more relaxed and all staff were happy that there were no welfare problems arising.

- Wood species. Performance of the woodchip as a bedding material was not affected by the species of the wood.

- Moisture content of wood. Results from this study and from communication with colleagues at Llysfasi and the Pontbren group indicate that the moisture content of the wood has the greatest effect on the viability of woodchip. It is essential that the wood is cut far enough in advance (minimum 6 months) to achieve a moisture content of 20-30%. Due to the voluminous nature of woodchip it is best stored and seasoned in the round and then chipped prior to use. Woodchip also tends to absorb moisture easier than wood in the round and has the potential to increase in moisture content if stored chipped. Results from ADAS show less of the 20% woodchip was used than the woodchip at 40% and 60% moisture contents. This is due to the greater absorbency of the 20% woodchip. Despite applications being required at the same frequency as the 40% and 60% woodchips the quantities required were less.

- Diet of animal. The moisture content of the diet had a major effect on the quantity of woodchip used, at IGER, but not such a big effect on the quantity of straw required. This was due to the differing moisture contents of the bedding materials. At IGER the straw had a moisture content of 15% whereas the moisture content of the woodchip was approximately 50%. This clearly shows how the performance of the woodchip is compromised if the correct moisture content is not achieved. Straw bedding had the absorbency to cope with the different diets.

- Type of chipper and size of woodchip. From preliminary research carried out by Phil Potter (forestry consultant) and Aldwyn Clarke (ADAS) it was decided to use a Laimet HP25, screw cone chunker wood chipper. This is a pto driven machine that can chip wood up to 250mm in diameter and achieves a chip size of approximately $30mm^3$. However, as previously explained this machine was not used for all the chipping and the Heizohack HM8-400 was also found to produce chips of the required standard.

- Practicalities of handling woodchip. Due to the voluminous nature of woodchip it requires mechanical handling preferably using a telescopic handler with a bucket. Glynllifon did experience problems with handling the woodchip as they did not have the same facilities as IGER and ADAS. Old buildings with low roofs do not lend themselves to using woodchip purely because they cannot accommodate the machinery. The type of building may be a deciding factor for some farmers who are considering woodchip as a bedding material.

- Management system. The quantity of woodchip used can be affected by the set up of the shed and the management system adopted. For example, a shed that allows good drainage will be beneficial particularly if the optimum moisture content of the woodchip was not achieved. A scrape clean area at the feeding face allows regular removal of wet faeces and could significantly reduce the amount of woodchip used.

- Cost of woodchip. The objective of this initial study was to evaluate the performance of the woodchip as a bedding material. Detailed costings have not been included here but form part of the studies reported in Reports 2 and 8. Work on the selected demonstration farms included full costings and provide more realistic figures as the wood will be sourced and chipped in a commercial environment. The woodchip sourced for the three development sites (as described in this report) was more expensive than straw and indicates therefore, that careful consideration is required before making woodchip the primary bedding material on a farm.

APPENDIX 1

Specifications of chippers used in this project

The Laimet HP-25

The Laimet HP-25 is a tractor or diesel powered chipper suitable for professional use. Like all Laimet chippers, the HP-25 uses a conical screw blade, producing splinter free and even quality chips. The rotating screw blade also functions as a feed unit, making a separate manual feed unnecessary. There are 5 different chip sizes, ranging from 15-25mm up to 60-100mm.

The rate of production ranges from 40 to 120m^3 per hour, depending on the blade used as well as the size and type of wood. This chipper is suitable for all types of clean wood: coniferous and deciduous wood, thinnings, tree tops, pruned and unpruned saplings, blocks, sawn surfaces and also frozen wood. The HP-25 can chip wood up to 230mm in diameter.

Woodchip from the Laimet are suitable for use in heating, in composts and as animal bedding.

The Heizohack HM8-400

The HM8-400 is capable of chipping all types of wood: pallets, waste wood, slab wood, hedges and coniferous and deciduous wood up to 40cm in diameter.

This chipper is fitted with a drum-chipping rotor incorporating small individual knives mounted at intervals around the drum. The size of chip (20-50mm) is adjustable by exchangeable sieves with different hole dimensions. The infeed for the chipper is a powerful single top feed roller in conjunction with a lower steel slatted conveyor having separate welded teeth.

The Greenmech Chipmaster 220MT55

The Greenmech chipper will accommodate wood up to 9" in diameter and can either be fitted with its own diesel engine or is tractor mounted.

It has a disc-blade chipping system that ensures a constant chip quality and has the ability to chip 7 tonnes of material per hour.

The Jensen A328 PTO Chipper

This Jensen chipper also uses the disc blade chipper similar to the Greenmech model.

Its power requirements are 60hp and it can chip wood up to 11" in diameter. The output of this machine is approximately 17m^3 per hour depending on type of wood.

ACKNOWLEDGEMENTS

HCC gratefully acknowledges the participation of the following organisations;

- ADAS Pwllpeiran
- IGER Aberystwyth
- Glynllifon College
- Welsh Assembly Government
- Forestry Commission Wales
- Environment Agency Wales