

Teagasc

Research Report 2008

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BEEF AND SHEEP PRODUCTION RESEARCH
ANIMAL BIOSCIENCE RESEARCH

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INTRODUCTION

Teagasc, the Irish Agriculture and Food Development Authority, provides the Agriculture and Food industries with research, advice and education (Figure 1).

The organization which has 1,500 Teagasc staff at 100 locations and a budget of €170 million is governed by an Authority with a Chairman and representatives of key stakeholder groups appointed by the Minister for Agriculture, Fisheries and Food.

Two hundred agriculture research projects, in the four major programme areas of - Animal, Crop, Environment, Economics and Rural Research, are carried out by 250 professional staff. The work reported here was conducted at Grange Beef Research Centre, Livestock Research Centre, and the Animal Bioscience Centre.

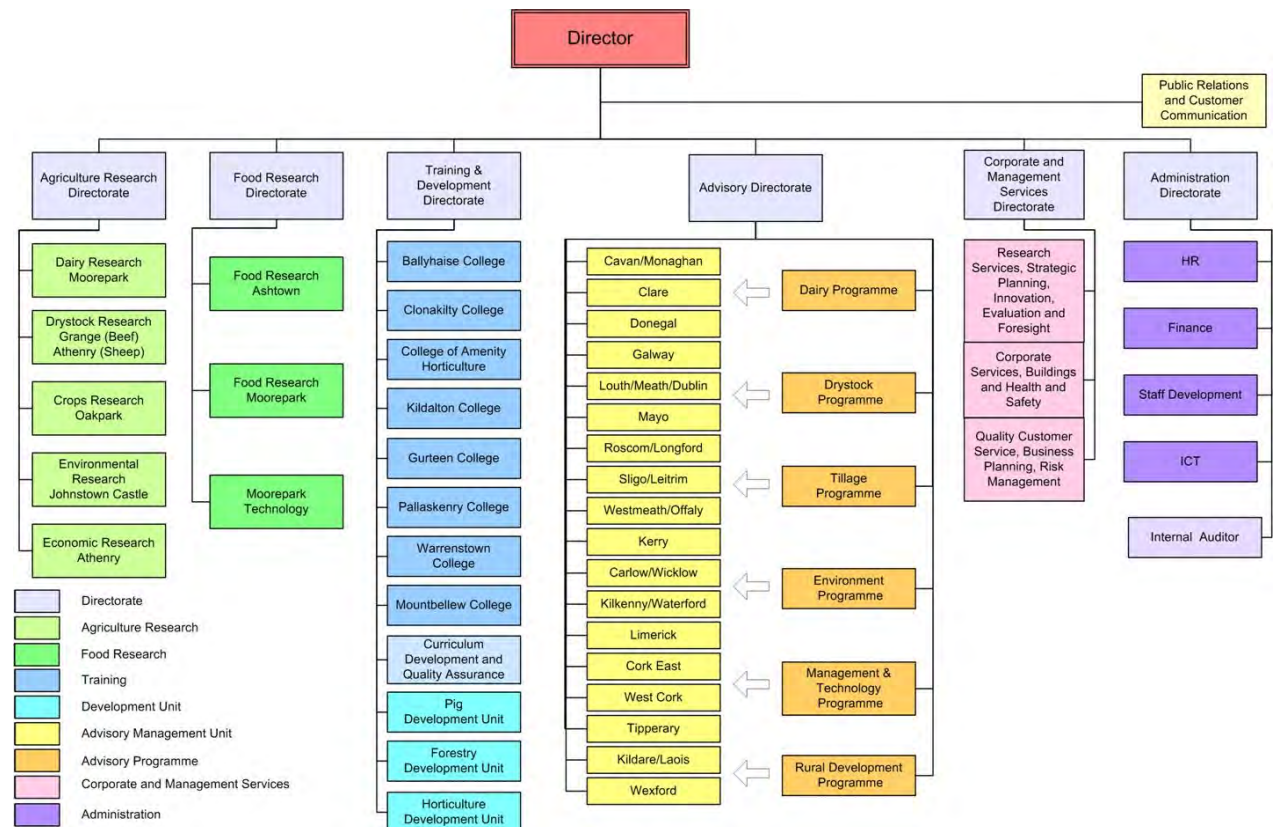


Figure 1. A representation of the structure of Teagasc combining research, advise, education, administration and corporate management activities

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HIGHLIGHTS FROM THE 2008 BEEF RESEARCH PROGRAMME

In **beef systems research**, a study was undertaken to compare pasture and indoor finishing of spring-born Aberdeen Angus x Friesian and Belgian Blue x Friesian steers. The study aimed to compare the two crosses for growth and carcass traits. The study concluded that Belgian Blue (BB) cross animals grew faster than Aberdeen Angus (AA) crosses resulting in 4% greater slaughter weight. Due to a higher kill-out proportion, carcass weight was 7% greater for BB. When account is taken of their higher ribs joint muscle proportion, estimated muscle production was 18% greater for BB. Scaled for mean live weight, feed intake was 3-4% lower for BB. For AA, carcass fat class exceeded 3 and *m. longissimus* lipid concentration exceeded 25 g/kg, at carcass weights above 270 kg. At carcass weights above 330 kg, AA carcass fat class exceeded 4 and *m. longissimus* lipid concentration exceeded 45 g/kg. In contrast, BB did not reach carcass fat class 3 or a *m. longissimus* lipid concentration of 25 g/kg until carcass weight exceeded 300 kg. During the autumn grazing period, the live weight and carcass weight gains on pasture were less than half those on concentrates, and up to an early slaughter date, the conversion ratio of concentrate DM to carcass weight gain was 10.8:1. At an early slaughter date (18-20 months of age), neither breed type produced acceptably finished carcasses (fat class 3) on pasture only, but both breed types produced acceptably finished carcasses on *ad libitum* concentrates. At the late slaughter date, the AA carcasses, fed on pasture followed by concentrates indoors, were acceptably finished, while those finished on concentrates throughout were over fat. The opposite was true for BB, in that the animals fed on pasture followed by concentrates indoors did not have acceptable fat cover (by 20 months of age), whereas those finished on concentrates throughout did.

The implications of these findings are that spring-born, early maturing beef breed x dairy steers can be finished for slaughter in the late autumn/early winter of their second year at a carcass weight of 270 kg upwards following a 2-3 month feeding period on *ad libitum* concentrates. Even though late maturing breed types have heavier carcasses at the same age, they require a longer period of concentrate feeding to produce acceptably finished carcasses. This period must be extended further when the animals undergo a period of slower growth on autumn pasture before concentrate feeding commences.

Examining national trends in beef carcass classification over the 8-year period 2000 to 2007, showed carcass conformation of steers improved slightly to 2003 and then declined slightly with the result that it was little different in 2007 to what it was in 2000. Heifer conformation followed a similar trend but the changes were somewhat greater with the result that in 2007 carcass conformation was 0.22 of a class better than in 2000. Carcass fat class decreased consistently over 8 years and was 0.63 (steers) and 0.50 (heifers) of a class lower in 2007 than in 2000. There did not appear to be any relationship between carcass classification values and the proportions of beef and dairy crosses, the level of live exports, the breed composition of the cattle population or mean carcass weight. There was also little evidence of any effect of the change from visual to machine classification.

A winter feeding study was undertaken to compare the effect of brassica species (kale and swedes), silage supplementation (with or without) and indoor feeding, on growth of young bulls during late winter (6 weeks). The preliminary results indicate the average daily gain of bulls feeding on kale and swedes as the sole diet was, respectively, 0.54 and 0.94 kg/day, and 0.87 and 0.68 kg/day for those on kale and swedes with silage and 0.68 kg/day for those indoors on silage with concentrate.

In **beef genetics** a study was undertaken to compare growth, feed intake and slaughter traits of progeny from two contrasting beef breeds selected for either high or low genetic merit for growth, and of two dairy strains of contrasting origin, to determine if genetic merit effects

were consistent across two slaughter weights, and to elucidate interactions between genetic group and the production factors employed. Male progeny of 23 beef sires of either high (13 sires) or low (10 sires) genetic merit for growth rate (EPD_{CWT}) were sourced from commercial Holstein-Friesian dairy herds in spring 2006. The beef sire breeds were Aberdeen Angus (10 sires) and Belgian Blue (13 sires). In addition to the beef breeds, male progeny from Friesian sires (7 sires) and Holstein sires (12 sires) were also sourced.

The study concluded that progeny of sires of high genetic merit for growth rate grew faster and produced heavier carcasses. The extra carcass weight was attributable mainly to their higher growth rate and slaughter weight rather than to an increased kill-out proportion. High merit progeny exhibited greater muscle depth and were more compact as indicated by their lower body measurements per kg live weight. There were interactions between genetic merit and beef breed for growth and carcass weight traits, implying that the expression of genetic merit differed between the breeds. It was clearly evident in Aberdeen Angus (AA) but not at all in Belgian Blue (BB). Differences between the beef breeds were as expected and in line with their known patterns of maturity. The results confirm the advantages of the late maturing beef breeds for beef production traits, with BB being more compact and having superior carcass traits to AA. In summary, use of sires of high genetic merit for growth rate improves beef performance through increased live weight gain and greater carcass weight, but these effects were not consistent across breed types. The expression of genetic merit was not dependent on feeding level or slaughter weight.

Another beef genetics study examined residual feed intake (RFI) which is defined as the difference between an animal's actual intake and its predicted intake, and is independent of growth and body size. The objective of the study was to characterise productivity related variables in pregnant beef heifers differing in phenotypic RFI. Pregnant heifers with high RFI had 0.14 and 0.21 higher dry matter intake than those with medium and low RFI, respectively. Live weight, average daily gain, body condition score, ultrasonic muscle and fat depth, skeletal measurements, blood variables, calf birth weight and calving difficulty score did not differ between RFI groups. Muscularity score was higher for low than high RFI heifers, with medium RFI animals being intermediate. Mean rumen pH and molar proportion of acetic acid did not differ between RFI groups for purebred heifers, but were higher in the high than the medium and low RFI crossbred heifers, which were similar. There was no effect of RFI on mean values for other rumen fermentation variables. Proportion of time spent lying, standing and active did not differ between the RFI groups.

In **grassland research** a study was undertaken to help to understand how pasture growth rate is affected by date of N fertiliser application in spring, by examining the responses to N fertiliser relative to soil temperature for pastures with contrasting grazing regimes within a rotational grazing system. The results from this study suggest that soil temperature (5 cm) could be useful as an indicator of when to apply N fertiliser in spring. The pasture growth response to N fertiliser was greater when the fertiliser was applied at soil temperatures above 5-6°C within a year-round rotational grazing system for beef cattle at Grange.

The study also examined the response to five rates of N fertiliser applied to pasture in spring with contrasting grazing regimes within a rotational cattle grazing system. There was a positive pasture response to N fertiliser. Overall response was 32.0, 17.2, 17.3 and 15.3 kg DM/kg applied N for 28.8, 57.5, 86.3 and 115 kg/ha of N fertiliser, respectively. Relative yield response was described by the asymptotic model $y = 115.9 - 60.8(0.989^x)$ ($R^2 = 0.602$). The asymptotic relationship between the relative yield and N fertiliser rate suggests that average response of 70-80% of the maximum were obtained with 28.8 to 57.5 kg N/ha in spring, for pastures within a year-round rotational grazing system for beef cattle at Grange.

In **forage conservation** the factors influencing the conservation characteristics of baled silage was investigated. This experiment compared the conservation characteristics of baled silage

(BS) and precision-chop silage (PS) made following three durations of wilting and, in the case of BS, investigated the interactions with the number of layers of plastic film in which the bales were wrapped and the duration of ensilage. The study concluded that differences between BS and PS were relatively small, whereas, both field wilting and preventing air infiltration during ensilage conferred benefits to the conservation characteristics of BS. Extending BS storage from 7 to 18 months disimproved the conservation characteristics mainly in unwilted BS. Thus, the differences reported between BS and PS on farms are most likely due to differences in herbage DM content and the completeness of anaerobiosis during ensilage rather than to the chopping or storage system used.

In other baled silage research a study was undertaken to investigate the effects of herbage dry matter concentration on bacterial community composition during ensiling, employing conventional methods of microbial analysis and culture-independent Terminal Restriction Fragment Length Polymorphism (T-RFLP). It is concluded that herbage DM concentration has a major effect on silage bacterial composition and in turn on the outcome of preservation. While conventional methods of microbial analysis reveal differences in the numbers of bacteria present, T-RFLP can provide greater insight into the changes in bacterial community composition and can provide an overview of the whole community in one assay.

A study on forage maize composition examined the interaction of harvest date, plastic mulch and cultivar by comparing two cultivars of forage maize that were grown with or without plastic mulch and examining how composition altered between early September to early November. Starch content was increased by sowing the crop under plastic mulch, and was higher with Tassilo than Benicia. *In vitro* dry matter digestibility declined as harvest date was delayed, and was higher with the earlier maturing Tassilo than the later maturing Benicia, this being especially evident at the earlier harvest dates. Plastic mulch increased digestibility, mainly at the earlier harvests. It also increased digestibility more with Benicia than with Tassilo. Both NDF and ADF declined with later harvesting, with the rate of decline being faster with Tassilo than Benicia, and where plastic mulch was used. Ash concentration declined over time, and was particularly reduced when the crop was grown under plastic mulch. This study concluded that plastic mulch modified forage maize chemical composition in line with advancing its stage of maturity and this effect was most evident with the earlier maturing cultivar when harvested in September.

Another forage conservation study examined alternative conservation strategies for high-moisture barley grain. The objectives were to quantify the conservation characteristics of barley grain harvested at different stages of ripeness and stored anaerobically following contrasting processing and additive treatments. The study concluded that high moisture barley grain stored anaerobically for durations in excess of 100 days can undergo efficient conservation with relatively small quantitative and qualitative losses. Such conservation can be conducted over a wide range of stages of ripeness with whole or rolled (i.e. crimped) grain. Grain conserved satisfactorily without additive, and the contrasting additives used had different effects. Caution is required if extrapolating these results to what might happen at a farm scale due to the greater challenges associated with rapidly achieving and maintaining anaerobiosis on farms.

In **beef systems modelling** a study was undertaken to examine the effect of beef cow genotype and replacement policy on the profitability of grassland-based suckler beef systems. Since a change in genotype may have implications for the fertility of the suckler herd, the impact of replacement rate was also explored. This study demonstrated that for suckler farmers, sourcing replacements from the dairy herd results in greater profitability due to higher output; a consequence of heavier liveweights at sale and greater numbers of animals sold. Heavier weights obtained for the Beef \times Friesian genotype are a result of higher pre-weaning weights due to the greater milk production of this genotype. Despite the late maturing beef breed (LM) genotype having a higher killing out percentage, the lower

finishing liveweight is not entirely mitigated and carcass weights remain lower than the beef × Friesian genotype. The lower animal output in the LM option is a result of the replacement policy employed; replacing from within the herd reduces potential animal sales. There was a modest effect of replacement rate on net margin. In general, the reduction in progeny sales was largely offset by the increase in cull cow sales.

Another modelling study was undertaken to investigate the impact of calving date and turnout date of the suckler cow herd on the profitability of spring-calving systems. Mean calving date and turnout date had considerable impacts on net margin with earlier calving and turnout dates associated with higher margins. When analysed across all systems, February calving systems had €25/ha and €80/ha higher net margins relative to March and April calving systems, respectively. Corresponding values for suckler cow turnout date were €32/ha and €86/ha, respectively. The impact of advancing calving date and turnout date by one day was to increase net margin by €1.75/ha (€1.41/cow) and €1.90/ha (€1.54/cow), respectively. Over all scenarios, margins were €16/ha higher for the high intensity systems relative to the low intensity systems. It is apparent that earlier calving and turnout is associated with lower grass silage requirements and higher proportions of grazed grass in the annual feed budget. Consequently, the key underlying difference between the systems revolved around feed and slurry handling costs. Where soil and weather conditions are suitable and where there is an adequate herbage supply, this analysis has shown that earlier calving and turnout date to pasture can lead to greater profitability in suckler beef systems by reducing slurry handling and feed costs.

A further study was undertaken to investigate the impact of turnout date of yearling cattle on the profitability of spring-calving suckler beef systems. Due to the effects of compensatory growth, gross output values for three contrasting turnout dates were similar. However, later turnout dates were associated with higher production costs, with March and April turnout incurring €18/ha and €44/ha, respectively, higher production costs than February turnout. Higher production costs were due to higher feed and slurry handling costs. The proportion of grazed grass in the annual feed budget was reduced from 62% in the February turnout scenario to 58% in the April turnout scenario. The analysis indicated that advancing turnout to grass of yearling cattle by one day increased net margin by €1.17/ha (€0.95/cow). When analysed across all turnout dates, the high intensity systems had €15/ha higher net margin than the low intensity system. Increasing stocking rate had a greater impact on net margin for earlier turnout dates.

A further modelling study was undertaken to investigate the effects of pasture responses to spring N fertiliser on the profitability of suckler beef systems with different spring-calving and turnout dates to pasture. The results have important implications for optimal calving and turnout dates on Irish suckler beef farms. In general, earlier calving and turnout improved farm net margins by reducing the proportion of more expensive grass silage and concentrates in the annual feed budget and replacing it with cheaper grazed grass. Furthermore, slurry handling costs were greater where turnout was delayed. However, the capacity of earlier calving and turnout to increase farm net margin was dependent on the pasture response to applied N in spring. Where responses were poor (5 kg DM/kg N), March calving and turnout improved net margins relative to February calving and turnout. Overall, the results suggest that turnout should be as early as conditions and pasture availability allow. Whilst grazing conditions are largely dependent on soil, climatic and weather conditions and is therefore, largely outside the farmer's control, farmers can have an influence on pasture availability by appropriate autumn grassland management and judicious application of N fertiliser.

In **environmental studies** one strategy being explored for reducing emissions of enteric methane (CH₄) from cattle is to increase the starch and reduce the fibre content of the diet. The associated expected improvement in the rate of growth should further reduce CH₄ emissions per unit of weight gain. The study examined the effects of altering the ratio of grain

to straw in whole-crop wheat silage on CH₄ emissions and associated performance parameters of finishing beef steers, and ranked these relative to grass silage and *ad libitum* concentrates. It concluded that increasing the ratio of grain to straw in whole-crop wheat silage had a quadratic effect on CH₄ emissions when expressed either as g/day or g/kg DM intake, but resulted in a linear decrease when expressed as g/kg carcass gain. An *ad libitum* concentrate diet consistently reduced CH₄ emissions compared to forage based diets while the effect of grass silage varied with the units of measurement in which CH₄ emission was expressed. Liveweight and carcass gains increased with increasing grain to straw in whole crop wheat silage and were lower than *ad libitum* concentrates but similar to grass silage.

In **animal nutrition and beef quality** research it is concluded that feeding wilted grass silage with a sunflower oil-containing concentrate during winter increased redness, yellowness and saturation of muscle. However, long term supplementation of grazing heifers with a sunflower oil-containing concentrate increased lipid oxidation. By all indices of colour stability, previously-frozen muscle was less stable than fresh muscle, regardless of diet.

Another study was undertaken to compare the colour of subcutaneous fat and the colour and eating quality of *longissimus dorsi* muscle from heifers reared on grass or concentrate diets. The study concluded that the absolute difference in colour values was quite small and may not be visually detected by consumers. A difference was only observed in texture where steaks from concentrate-fed animals were more tender and this effect on tenderness was reflected in the taste panel preference ratings.

In the **animal bioscience** programme, a study evaluating the relationship between residual feed intake/net feed efficiency and transcription of genes provided evidence of an association between mitochondrial biogenesis and feed efficiency. PGC1- α and PPAR- γ may be potential indicators for feed efficiency as both were independent of growth but further investigation is warranted to determine if these can be exploited as potential molecular markers for energetic efficiency in cattle.

The results of a study evaluating the relationship between net feed efficiency and expression of genes controlling the IGF system in skeletal muscle tissue of cattle suggest that it is unlikely that the IGF system plays a significant role in the local regulation of energetic efficiency in skeletal muscle.

A further study on feed efficiency compared the ruminal microbial populations of cattle divergent for net feed efficiency, across contrasting diet types and concluded that significant differences were found in the rumen microbiota which may be associated with feed efficiency in beef cattle.

A further study looked at single nucleotide polymorphisms in the bovine *NPY5R* gene which may influence feed intake behaviour in cattle, and, may, thus, in the future act as a potential genetic markers for selection of animals with high feed energy utilisation efficiency.

In a microarray study examining endometrial gene expression in heifers of high and low fertility, 126 genes were found to be differentially expressed in the low relative to the high fertility group, of which 85 were up-regulated and 41 down-regulated. Genes mapped were implicated in an array of biological pathways including reproductive function, tissue development, immune response, cell-cell signalling, energy coupling and cell death. The study concluded that the expression of genes involved in key biological pathways including reproductive processes are differentially regulated in animals of high versus low fertility.

A further study examined the effects of dietary supplementation of n-3 PUFA on the expression of genes involved in the IGF signalling system in the bovine uterine endometrium

and liver. Uterine endometrial IGF receptors, IGF binding protein genes were found to be differentially expressed in the supplemented animals. Expression of mRNA for the IGFBP-1, IGFBP-4, IGFBP-5, and growth hormone receptor were not differentially expressed in endometrial tissue. Hepatic IGF-2R, IGFBP-5 and GHR-1A genes were found to be differentially expressed in the supplemented treatment. Expression of mRNA for a number of IGF acid labile subunit and GHR were not differentially expressed in liver tissue.

A further study, using two contrasting beef cattle breeds, was undertaken to examine the effect of breed and genetic merit potential on muscle gene expression for muscle growth and development in the *Longissimus dorsi* muscle. The genes coding for Collagen type II, IGF-1, IGFBP-3, Follistatin and Growth Hormone receptor were found to be differentially expressed in *Longissimus dorsi* muscle of genetically high and low steers. A breed effect was noted as mRNA levels of collagen type II were higher in Aberdeen Angus crosses compared to Belgian Blue crosses. Although several of the genes involved in the IGF system remained unchanged, expression of IGF-1 varied between breed and genetic groups, with genetically low animals having a higher expression. The genes studied to date show significant differences for both breed and genetic groups.

A study was undertaken to determine the efficiency of immunodepletion spin columns in removing bovine serum albumin (BSA) from bovine plasma. The study showed that BSA immunodepletion spin columns are an efficient and rapid method for the depletion of the highly abundant protein albumin from bovine plasma. The spin columns showed high recovery of protein and high specificity for the removal of albumin

In an **animal welfare** related study, the objective was to examine the effect of abrupt weaning on circulating leukocyte subsets and phagocytic activity of neutrophils in beef suckler calves. It was concluded that abrupt weaning resulted in increased neutrophil number but the functionality of these cells to potentially traffic and phagocytose efficiently was impaired. The data suggests that there was a greater transitory reduction in immune function in abruptly weaned than non-weaned beef suckler calves.

In a related study to determine the effect of abrupt weaning and subsequent housing on leukocyte populations and acute phase proteins in beef suckler cows, it is concluded that, following abrupt weaning, that a transitory stress response, similar to that exhibited by abruptly weaned beef calves, is also evident, although to a much lesser extent, in beef cows. Thus, suggesting that cows may be less sensitive to weaning stress than their calves. Results indicate that there was a transitory reduction in immunity in cows immediately post-weaning and to a lesser extent post-housing.

In a study which examined the immune response to physiological stress in cattle divergently ranked for feed energy efficiency, the data suggests that divergent selection for animals with low RFI will not compromise their immune function.

HIGHLIGHTS FOR THE 2008 SHEEP PRODUCTION PROGRAMME

In a **nutrition** study examining the effects of maturity of maize at harvest, protein supplementation, feed value of grass silage and potential concentrate sparing effects of high feed value grass silage and maize silages on the performance of pregnant ewes and their progeny, it was found that increasing maturity of maize at harvest increased ewe post lambing condition score (CS) and weight, but did not alter lamb performance. Supplementing maize with soyabean meal increased post lambing ewe CS and weight, and lamb birth weight but did not alter lamb performance. Increasing grass silage feed value increased post lambing ewe CS and weight and lamb birth and weaning weights.

Another study was undertaken to evaluate the effects of plane of nutrition at different phases during the rearing regime of replacement ewes, differing in genotype on subsequent lifetime performance, and it concluded that whilst altering the plane of nutrition during different stages of the rearing phase increased ewe liveweight by up to 36%, there was no effect on litter size or number reared. Plane of nutrition during the first winter had the greatest effect on subsequent lamb birth and weaning weights. The weight of lambs weaned per ewe was 67% higher for the Belclare-X than the Charmoise-X due to a combination of higher litter size (0.51) and higher progeny growth rate (+30 g/day).

In a second study which evaluated the effects of level and type of concentrate supplementation with maize silage diets on ewe and subsequent lamb performance, it is concluded that there is no benefit to supplementing ewes offered maize silage with protein in mid pregnancy. During late pregnancy concentrate supplementation can be reduced to approximately 10 kg of soyabean meal without having a negative impact on ewe or subsequent lamb performance.

A **grassland** study was undertaken to evaluate the effects of herbage allowance and frequency of allocation to ewes in mid pregnancy on ewe and subsequent lamb performance. The effects of extended grazing management on subsequent herbage yield and ground cover were also evaluated. The study concluded that increasing herbage allowance increased ewe condition score at the end of extended grazing and at weaning, and total protein concentration in plasma, decreased plasma NEFA concentration, and tended to decrease the number of lambs born dead. Herbage allowance did not alter lamb birth or weaning weights. Increasing herbage allowance at grazing increased subsequent herbage yield and decreased the proportion of bare ground. Frequency of herbage allocation did not alter subsequent herbage yield or the proportion of bare ground. It also concluded that to maximise stock carrying capacity and reduce labour requirement and herbage allowance of 1 kg DM offered twice weekly is adequate for ewes in mid pregnancy.

A **hill sheep** project assessed, changes in the frequency and composition of the un-improved vegetation, sustainable agro-environmental management of hill and mountain peatland and the impact of hill sheep activity on the population dynamics and diet of small mammals. The largest change occurred in the incidence of 'No vegetation', mainly bare soil with outcropping rock, which decreased from 35.5 to 17.2% of the area. While all vegetation groups increased over the period, grasses, which consisted mainly of *Molinia*, were dominant throughout and had the highest percentage point increase – 24.6 to 30.2%. Overall mean vegetation height in 1999 and 2008 was almost static at 21.4 and 21.9 cm respectively.

In a further hill sheep study examining the reason for culling hill sheep (broken mouth), the results indicate that selection on dentition score in ewes can be used to reduce the incidence of mal-occlusion of incisors and the phenotypic data summarised supports the concept that reducing the incidence of mal-occlusion would reduce the emergence of 'broken mouth' condition and thus increase the productive life of ewes in the hill flock.

A related study examined whether the existence of established home ranges within a flock existed, in that ewes not born and reared on the same hill will be disadvantaged, if introduced to that hill, compared with ewes born and reared on the hill. The performance traits did not reveal any evidence for under-performance by purchased stock. In fact the purchased stock were significantly heavier at around mating and litter size was also higher. There was no evidence for significant effect on fertility. The data on ewes mortality did not yield any evidence either. Thus, the evidence strongly suggests that the performance of ewes born and reared on a hill farm is no more superior to that of ewes introduced to a hill flock from outside sources

A **sheep artificial insemination** study was undertaken to assess the fertilizing ability of fresh ram semen *in vivo* after storage at 5°C for up to 72 h. Sperm motility was lower at 48 and 72 h compared with 0 and 24 h. The results show that pregnancy rate decreased up to 72 h post semen collection. The significant breed effect was unexpected as generally ewe breed has not been reported as a source of variation in conception rate following AI with fresh semen.

In **sheep parasitology**, a two year study was established in 2008 to determine whether the growth rate difference between Suffolk and Texel lambs depended on whether the animals were exposed to significant larval challenge from the pasture. Up to mid July (when the lambs were ~17 weeks of age) pasture larval count was essentially zero for the 'clean' pasture, whereas the 'contaminated' pasture displayed the expected seasonal rise in the number of larvae.

The data showed values differed radically between lambs on the two pasture types. There was a clear increase in FEC for lambs on the 'clean' grazing between 14 and 18 weeks of age indicating that the same infective larvae were present on the 'clean' sward. However, the number of eggs per gram was only 23 for Suffolk lambs and 6 for Texels at 18 weeks and increased to around 150 eggs per gram at 23 weeks. The difference between Suffolk and Texel lambs was clearly evident at all time points for lambs on the 'contaminated' pasture and also evident at 18 weeks for lambs on the 'clean' pasture. Breed did not have a significant effect on growth traits although Suffolk lambs were grew somewhat faster and were heavier at weaning. There was a significant effect of pasture type on growth due to a better performance by lambs on the 'clean' pasture. However, there was no evidence for any breed-by-pasture type interaction for any growth trait. The results suggest that the higher FEC burden of Suffolk lambs under normal contaminated grazing conditions do not impair their growth performance relative to that of co-grazed Texel lambs.

In other parasitology work, evidence has emerged for the first time that snails other than *Galba (Lymnaea) truncatula* are hosts for *F. hepatica*. The new finding strongly suggests that *Radix peregrina* an intermediate host for *F. hepatica*. The evidence suggests that *Radix. peregrina* is an intermediate host of *F. hepatica*. This observation may in part explain the presence of infection in animals grazing acidic upland areas. Given the high prevalence of *F. hepatica* infection observed in *R. peregrina*, the role that *R. peregrina* plays in the transmission of liver fluke warrants further evaluation.