INFLUENCE OF FEED QUALITY ON THE EXPRESSION OF POST WEANING GROWTH ASBV's IN WHITE SUFFOLK LAMBS

Murray Long

ClearView Consultancy

www.clearviewconsulting.com.au

Findings from an on farm trial conducted in association with Farmlink Research Ltd.

Introduction

The use of ASBV's to select both rams and replacement ewes is now well entrenched in the Australian sheep industry. The advantages gained through the use of breeding values has been verified across many independent trials demonstrating significant increases in both performance and profitability across all sectors of the industry (Ramsay 2012). So what impact does environment, if any, have on the expression of these ASBV's in a commercial environment? The effects of Post weaning Fat (Pfat) ASBV's has been shown to effect both conception (Long 2015, Bred Well Fed Well, Ferguson 2012) and lamb survival (Bred Well Fed Well, Thompson et al 2012) although not equally across all environments (Ferguson et al 2010) with moderate levels of Pfat more advantageous to lamb survival in drier seasons. There has long been the question as to whether the expression of other ASBV's, especially growth, is affected by environment and what other considerations may be necessary if feed quality is likely to be limiting throughout the lamb's growth phase.

Methods

One hundred and fifty-eight (158) mixed age (3-6 years) White Suffolk ewes with known ASBV's were randomly allocated and joined to either high growth or low growth sires as listed in Table 1 with similar breeding values for fat and muscle. The rams were selected from a flock of commercially available rams with updated breeding values for fat and muscle used for calculations along with the more recent values for the ewes used in the trial.

Table 1. Carcase ASBV values of low growth and high growth rams plus ewes.

RAM ID	Pwt (Growth)	Pfat (Fat)	Pemd (Muscle)
131231	9.0	0.1	2.0
131291	11.7	-0.4	2.0
AVERAGE LOW	**10.3**	**-0.2**	**2.0**
131312	14.0	-0.5	1.8
131220	13.4	-0.5	1.3
AVERAGE HIGH	**13.7**	**-0.5**	**1.6**
AVERAGE EWES	**11.0**	**-0.5**	**0.8**

Ewes were scanned 92 days after ram introduction (average of 163% lambs in utero following a 6 week joining period) and managed as a single mob on Lucerne pasture until mid-way through the last trimester. Ewes Condition Score (CS) average was estimated at 4.1 at this time. They were then randomly split into treatment groups with equal numbers of Low growth and High growth joined ewes placed on either Lucerne pasture or native pasture to lamb down. These differing feed scenarios were maintained through lambing with the lambs kept on the different treatments for 4 weeks post weaning.

Individual lamb weights were taken at marking (day 60 from 1st lamb), weaning (day 141) and post weaning (day 167). Single and twin lambs were identified with this information allowing individual growth rates to be assessed and corrections for birth and rearing type. Condition Scores of the ewes from each treatment were assessed at weaning.

Results

Across Treatment

There was a marked difference in the Condition Score of the ewes from the two treatments at weaning with the ewes from the Pasture (native pasture) treatment averaging CS 2.45 compared to CS 3.85 for the ewes within the Lucerne treatment. There was also a considerable difference in the average weights of the lambs at weaning (day 141) across the two treatments with lambs from the Pasture treatment averaging 41.83 Kg compared to the Lucerne treatment average of 53.44 Kg.

The effect of treatment on the expression of the Growth (Pwt) ASBV's (Table 2) was as expected on Lucerne with lambs from the High growth sires (H LUC) producing higher growth rates than those from the Low growth sires (L LUC). However, when feed quality was low (Pasture treatment) there was no advantage expressed in the High growth sired lambs (H PAST) over the lambs sired by the Low growth sires (L PAST).

Table 2. Unadjusted Lambs weights from combined singles and twins

	Day 60 (Kgs)	**Day 141 (Kgs)**	**Day 167 (Kgs)**		**Growth rate (gms/d) Day 60-141**	**Growth rate (gms/d) Day 141 - 167**
H LUC	26.81	54.87	62.22		346.43	282.92
L LUC	24.90	52.01	58.44		334.71	247.29
H PAST	20.69	41.78	45.86		260.34	157.21
L PAST	20.43	41.89	46.17		264.83	164.84

Given that there was variation in twin survival rate across treatments, a correction in lamb weights of the twins was made to account for the differences in rearing type as seen in Table 3, but it made little difference to the trend observed from the unadjusted growth rates across treatments.

Table 3. Adjusted lamb weights to account for difference in twin survival between treatments

	Day 60 (Kgs)	**Day 141 (Kgs)**	**Day 167 (Kgs)**		**Growth rate (gms/d) Day 60-141**	**Growth rate (gms/d) Day 141 - 167**
H LUC	29.31	57.61	65.36		349.49	297.98
L LUC	27.02	54.69	60.84		334.50	259.50
H PAST	21.70	42.98	47.25		262.65	164.42
L PAST	21.39	43.74	48.25		275.84	173.63

The data still indicates a suggestion of a "penalty" in using high growth sires when feed quality is limiting and lower nutrition would be expected to affect twin lambs to a greater extent. To remove as much maternal and rearing type influence on the expression of Pwt ASBV's, only the single born lambs were included in Table 4.

Table 4. Weights and growth rates for single lambs only across treatments

	Day 60 (Kgs)	Day 141 (Kgs)	Day 167 (Kgs)		Growth rate (gms/d) Day 60-141	Growth rate (gms/d) Day 141 - 167
H LUC	29.3	58.0	65.3		354.32	280.77
L LUC	27.0	54.2	60.7		335.80	250.00
H PAST	21.7	43.2	47.1		265.43	150.00
L PAST	21.4	43.8	48.0		276.54	161.54

Within Treatment

The White Suffolk ewes in this trial had ASBV's for all the traits being evaluated and this allowed the opportunity to evaluate the impact of not only growth against feed quality but other carcase ASBV's. By calculating a mid-parent ASBV for the progeny across all traits, a more detailed assessment of the impact of feed quality in relation to carcase ASBV's could be undertaken

The average ASBV's of both the High and Low growth sires were combined with individual ewes to give a mid-parent ASBV for Pwt, Pfat and Post weaning muscle (Pemd) for all progeny. The average ASBV's for progeny from the treatments are shown in Table 5.

Table 5. Average Mid-Parent Carcase ASBV values of progeny

	Pwt (Growth)	Pfat (Fat)	Pemd (Muscle)
H LUC	12.53	-0.44	1.25
L LUC	10.52	-0.38	1.37
H PAST	12.45	-0.49	1.17
L PAST	10.33	-0.34	1.38

The calculation of individual mid-parent predictions of breeding values across growth, fat and muscle allowed the comparison of ASBV's against individual growth rates for the Lucerne and Pasture treatments. Figures 1 and 2 show the relationships for Pwt for both combined rearing types and singles.

Figure 1. Growth against mid-parent Pwt combined singles/twins

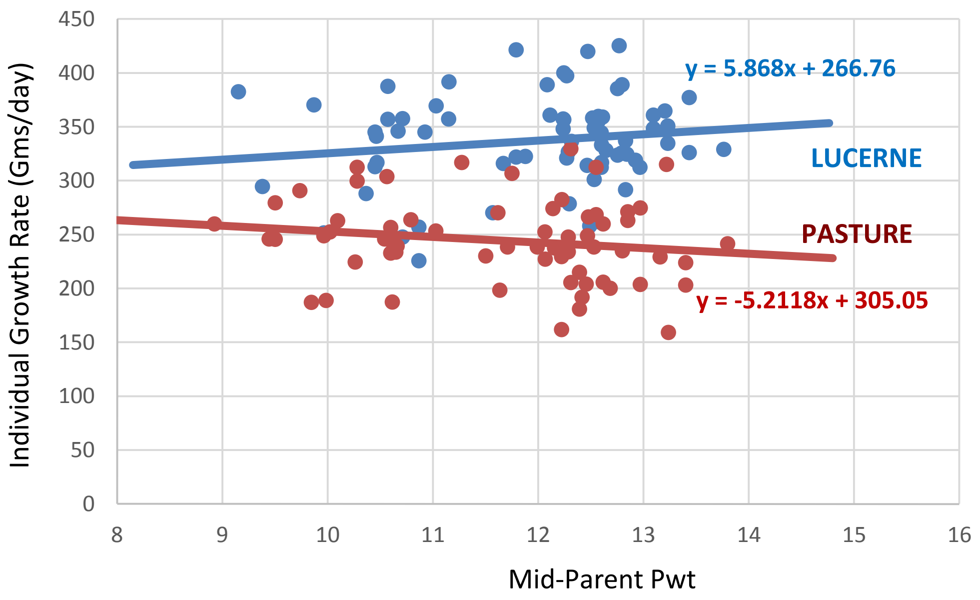


Figure 2. Growth against mid-parent Pwt singles only

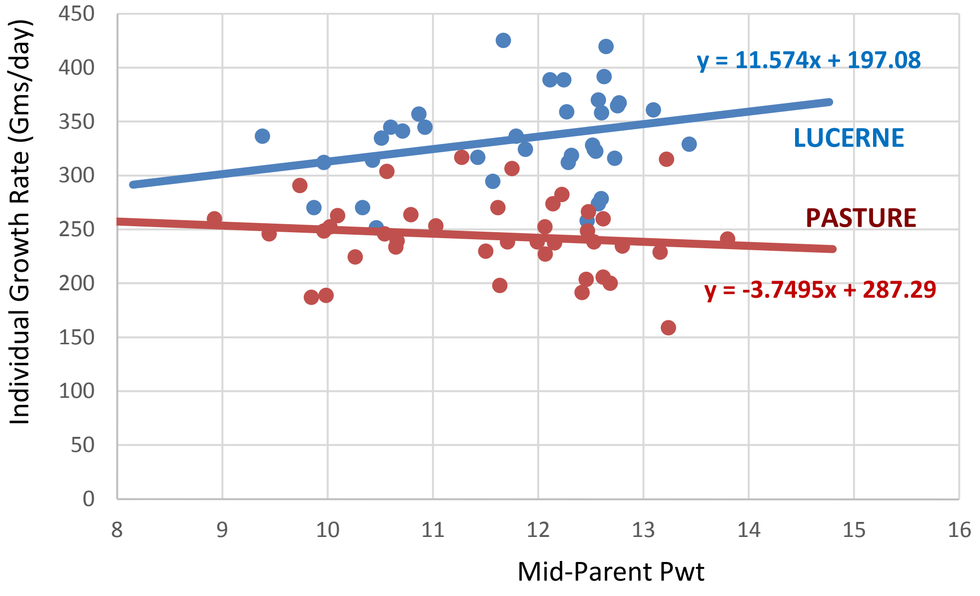


Figure 3. and Figure 4. also show the relationships for Pfat and Pemd ASBV's for the combined rearing types. The relationship for singles only are not included as the trends were the same but of a higher magnitude.

Figure 3. Individual Growth rate against mid-parent Pfat

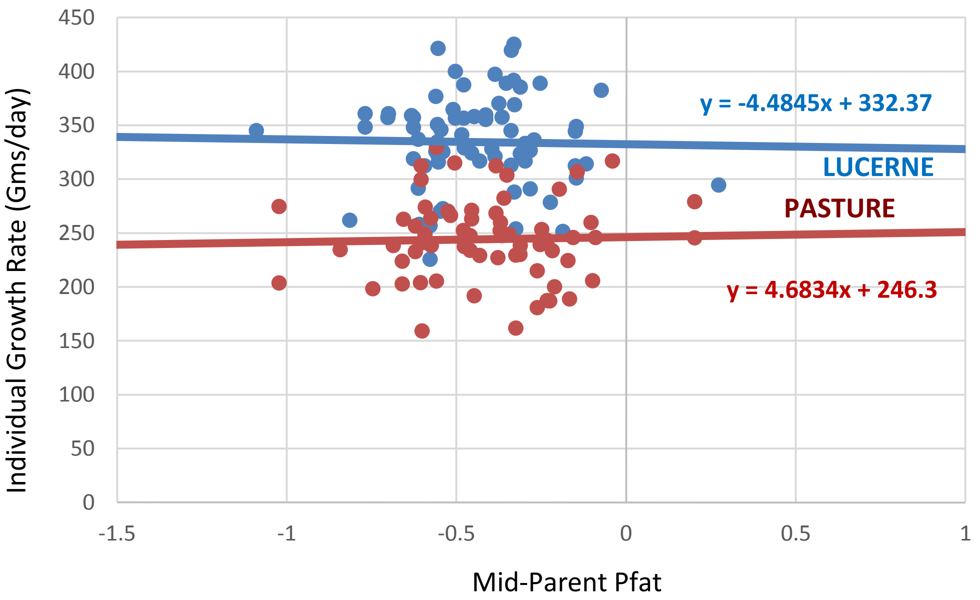
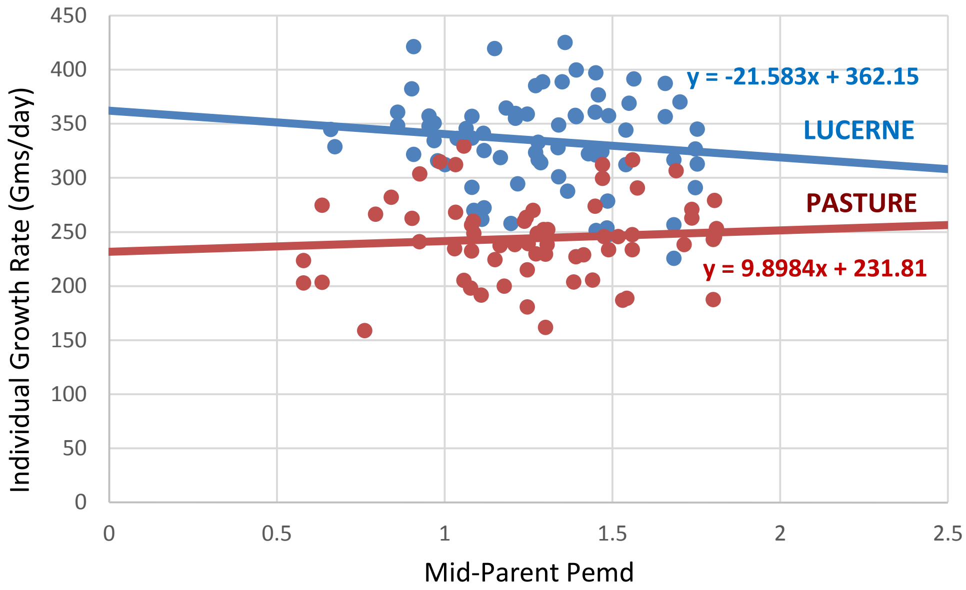


Figure 4. Individual Growth rate against mid-parent Pemd



Discussion

The disparity in feed quality and quantity accessible to the ewes and lambs across treatments in this trial was substantial resulting in a clear difference in ewe CS (3.85 v's 2.45) and a marked difference in the average weights of lambs across treatments. Under commercial operations, the ewes and lambs on the native pasture treatment would have been in a situation where supplementary feeding may well have been considered.

The response to higher growth ASBV's from lambs on Lucerne is what would be expected and has been shown in numerous trials relating to ASBV's (Ramsay 2012). The predicted weight advantage based on the ASBV's at 225 days (Post weaning) across the range of sires is the difference between average Pwt values of the sires used divided by 2.

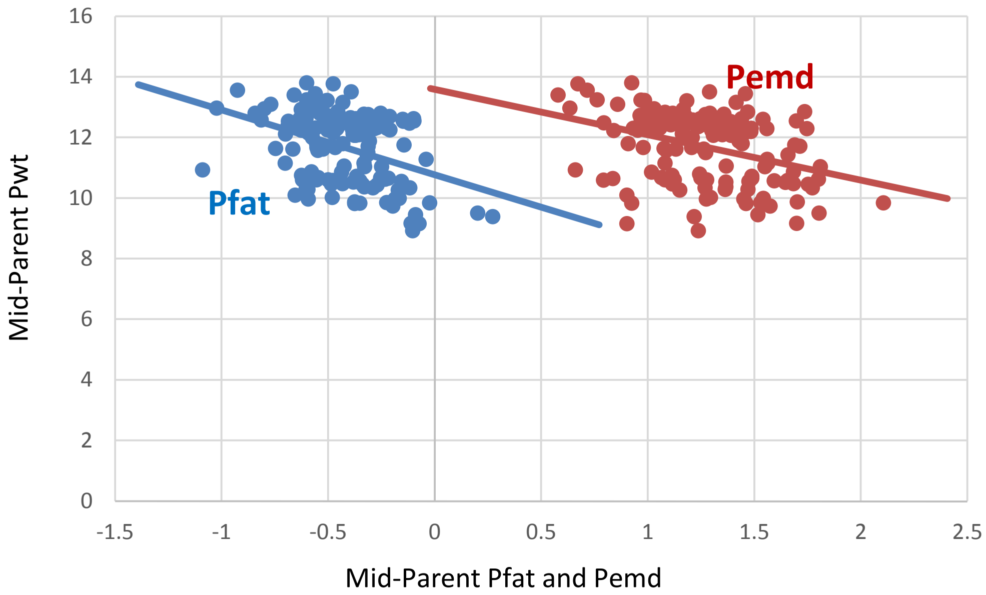
That is; (High Pwt – Low Pwt)/2 = (13.7-10.3)/2 = 1.7 Kg @ 225 days

In this trial the difference in weight between the high and low growth sires (4.6 Kg at 167 days) was appreciably greater than the 1.7 Kg predicted; even the difference between the treatments based on the mid-parent value of 2Kg underestimates the real gain in production. This finding has been the case for many "Proof of Profit" trials across a range of ASBV's (Ramsay 2012) and is further proof of the advantage that using ASBV's provides sheep producers.

The lambs born and raised on Lucerne achieved weight gains commonly found under good commercial grazing conditions while the lambs born and raised on lower quality feed were unable to reach their expected daily gains despite the higher genetic potential for growth. This finding has long been suggested by many breeders and industry (MLA 2007) emphasising the importance of good nutrition and suggesting a more moderate and balanced approach to selection based on a mix of ASBV's with consideration to environment, especially in marginal areas where both feed quality and quantity may at times be limiting. Gardner et al (2006) found a similar advantage of around 4kg when using higher growth sires with high nutrition but found a 60% reduction in this advantage on a lower plane of nutrition. They also found the effects of low nutrition affected the relative expression fat and muscle ASBV's and concluded a balanced approach to genetic selection using ASBV's was the best method to providing higher returns for producers. Hegarty et al (2006) found similar responses to the level of nutrition on the expression of the growth EBV's but found no nutrition effect across high and low breeding values for muscle with the advantage for high muscle sires maintained irrespective of the level of nutrition.

For lambs raised on Lucerne, growth was the predominant factor driving weight gain and the relationship with fat and muscle seemingly a negative one. This makes sense when we consider the negative genetic correlation that growth has with Fat and Muscle (ie. Higher growth = less muscle and less fat). Figure 5 shows the mid-Parent ASBV's for growth plotted against both Pfat and Pemd with both showing the negative correlation with Pwt ASBV. These correlations fully explain the apparent negative relationship seen in the Lucerne treatment when growth rate was plotted against either mid parent Pfat or Pemd. This negative relationship between Pemd and growth rate under high nutrition was also found by Hegarty et al (2006). Under good nutrition, growth rate ASBV's drive the potential weight gain of the lambs. However, this does not suggest that fat and muscle are not essential considerations in selection criteria as the benefits to carcase value are substantial. Selection for growth alone is not an option for commercial lamb producers.

Figure 5. Mid Parent Pwt ASBV v's Pfat and Pemd



The interesting finding from this trial is that when lambs were unable to attain potential high growth rates due to nutritional restrictions, there was no advantage of high Pwt ASBV's when compared to lambs with lower Pwt values. However when these growth rates were compared to the ASBV's for Pfat and Pemd, they appear to buffer and compensate for an inability to attain potential growth rates. More than likely, trial findings suggest that lambs sired by rams with higher Pfat and Pemd ASBV's are "protected" from relatively lower growth rates when grazing sub-optimal pastures. It could be this impact of fat and muscle on growth rate that seemingly causes a flat response to Pwt against growth rate as higher muscled and fatter genetics have correlated lower growth rates (Figure 5). At first glance it would seem from Figure 3 and Figure 4 that this is minor but for the single lambs only, this effect was markedly greater than for the combined twins/singles as seen in Table 6.

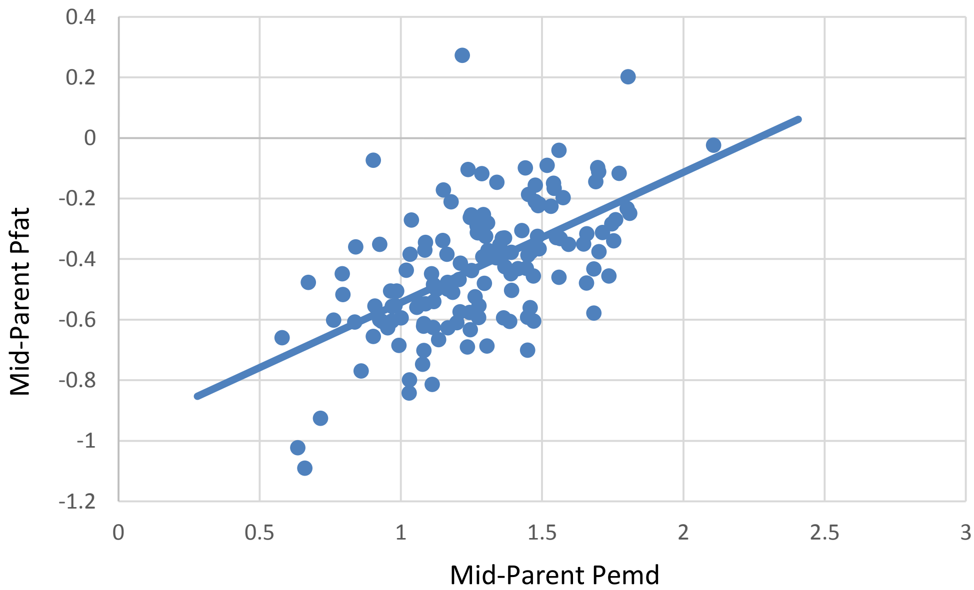
Table 6. Effect of a single ASBV unit increase on Growth rate (gms/day) across treatments

trait	LUC single & twin	PAST single & twin	LUC singles only	PAST singles only
Growth (+1 unit)	5.9	-5.2	11.6	-3.8
Fat (+1 unit)	-4.5	4.7	-63.0	22.0
Muscle (+1 unit)	-21.6	9.9	-29.2	23.1

This creates a different interpretation of the influence of Pfat and especially Pemd when feed is limiting. Assuming that the expression of growth potential is significantly curtailed when feed is limiting as previously found in other studies and in this trial, why doesn't the response of fat and muscle against growth rate follow the pattern to the same magnitude as that produced on Lucerne?

It could be argued that if the growth potential was reduced to the point of providing no advantage for high Pwt ASBV's, then the response observed against Pemd is the real effect it is having on growth rate. Hegarty et al (2006) found that the expression of Pemd (muscle) was not affected by level of nutrition therefore it would be expected that the lambs on Pasture with higher mid- parent Pemd values would have had higher levels of muscling than lambs with lower mid parent Pemd values. Hegarty et al (2006) also found a positive relationship between high muscle genetics and higher carcase weights under low nutrition, a similar response to that found in this trial. Gardener et al (2005) found that on low nutrition, high muscle sires with relatively low growth produced lambs with similar growth rates to those from high growth sires. They also found that high muscle genetics do not produce additional fat under high nutrition offsetting the increases in carcase weight of the high growth sires which had higher fat levels. This is supported by the work of Cake et al (2006) who found that lambs grown out under low nutrition had a higher proportion of muscle than their counterparts grown under high nutrition for the same 20kg carcase weight. Under high quality feed conditions, the relationship between Pemd and Pfat (Figure 6) encourages higher carcase fat levels driven by higher growth potential, under low nutrition the higher muscled genetics seem to result in higher carcase muscling, not higher levels of fat, and have a positive effect on buffering growth rate and maintaining carcase quality.

Figure 6. Relationship between mid-parent Pfat and Pemd



Despite the low quality of feed in the pasture treatment, these lambs still averaged a growth rate of around 250 gms/day to weaning. The combined effect of ASBV's for growth, fat and muscle and the balance of these traits is critical in achieving maximum potential gains across a range of potential seasonal challenges. It would seem that under feed limiting conditions, adequate levels of growth coupled with moderate fat and high muscle ASBV's are critical to achieving maximum flexibility of management and higher potential returns. This ties in with findings from a 2-year trial (Long unpublished 2006-07) where the Pfat of progeny was positively correlated with feed efficiency; more moderate levels of Fat, higher feed efficiency. If feed is to be limiting, more efficient genetics will make better use of those limiting resources.

The selection of genetics using ASBV's is a means to ensuring the best possible outcome in relation to, not only growth, but overall carcase shape and yield resulting in maximum profitability. While some knowledge of potential seasonal conditions and feed availability are possible, genetic selection has to take account of all probable situations and selection for extreme levels of growth (or any trait) may not the safest and best option. While there was no observed benefit from higher Pwt ASBV's in feed limiting conditions, there still remains the potential to take advantage of a favourable change in the season or a response to supplementary feeding when there is genetic potential for faster growth rates. Compensatory growth has been shown to exceed that of lambs on high value feed and the advantage of using high Pwt ASBV's is realised when higher nutrition is provided to these lambs (Hopkins 2012). Getting the mix of ASBV's right is the secret to ensuring that all potential feed conditions are covered to ensure maximum production regardless of the seasonal variations. The importance of providing good nutrition is vital in ensuring genetic potential is realised and the advantages that ASBV's impart leads to higher productivity and profitability.

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