Nutrition and Genetics for Velvet Production

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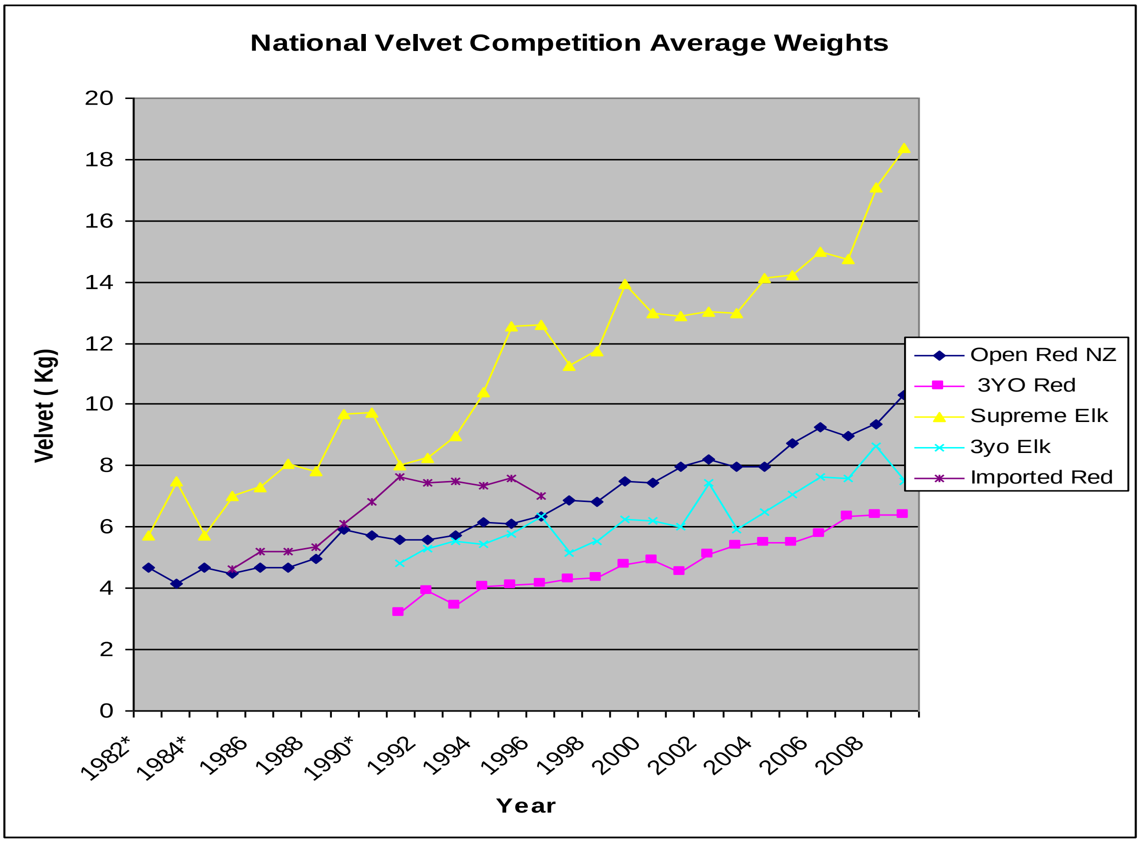
Introduction

The genetics of an animal determine the potential productivity of that animal. The nutrition that the animal gets then helps express that potential. Finally how we manage the environment of the animal to gain the required nutrition creates the final outcome. So, how we manage our farm has as much influence on the expression of genetics as nutrition might have. The application of assisted reproductive technology(AI and ET), combined with investment in the top antler genetics available, and the high heritability of velvet antler weight (heritability estimated at 0.42-45) has led the remarkable progress in productivity improvement as expressed by velvet weight. This is no more so that a review of the progress made in red deer and elk/wapiti as seen in the National Velvet Antler competition where the best heads in the country compete for national honours. Figure 1 shows the average weight for key classes including the 3 year old class since 1982, when the competition began. The key of course has been the excellence of feeding and management from these leading producers to deliver this genetic potential

Figure 1. The New Zealand national velvet competition results from 1982 to 2010 demonstrating the trend towards increasing genetic merit in the national velvet antler herd.



Previous information

When can we influence the expression of the genetics of velvet and antler growth? Much research has focused on feeding the stag during its adult life, trying to gauge what to feed and when. In our previous presentation to this gathering (Stevens et al 2002) we concluded that "any restriction in feeding stags for maintenance or growth phases, particularly from autumn until spring has a significant and negative impact on antler growth in New Zealand pastoral-based feeding systems." This hasn't changed. Jermy (2002) rightly states 'most importantly, antler potential is quickly compromised by poor nutrition. The simple message is to feed well... but overfeeding will not deliver anything other than what the stag is genetically capable of."

To avoid the problems of low pasture growth during late autumn until early spring it is recommended to provide supplementation. Recent research has also highlighted that it is not how much weight an adult stag losses in autumn that counts, but how fast he regains that condition in spring (Gaspar-Lopez et al 2010). This means that ensuring plenty of feed is available in the early spring, around casting time, is important to maximise velvet production.

Suttie's review of the many historical trials related to velvet growth in the 1970's and 80's's concluded that under feeding of stags reduced antler production in the following spring most severely when poor b nutrition was imposed during the late autumn post rut period, and again if nutrition was compromised in early spring. Further trials confirmed the underfeeding production loss as well. Work that attempted to redress this loss risk using enhanced protected soluble proteins instead of other protein supplements (peas) did not add significantly to velvet production. From that concept of good supplementation in general the concept of strategic enhanced feeding for velvet production evolved and started with utilising non pasture diets in combinations and at specific key times of the seasonal antler development cycle.

In practice the concept of strategic feeding at specific stages of the antler growth cycle to realise both potential beam dimensions and weight has been advanced adapting the pastoral situation along similar patterns to the Chinese pen feeding systems. (Suttie *et al.,* 1996). Specifically formulated diets combining protected protein(18%), protected fat (8%) and organically bound trace minerals amplifying copper and selenium (Bioplex TM 500, Cundy Technical Services) showed a variable but significant mean weight increase of 7% in commercial herds and strong improvement in antler grade.

Encouraged by the Chinese system that changes the balance of protein and energy through-out the year further developments in strategic feeding are indicated. During the antler growth period protein levels of 25% are targeted. Recent research with sika deer supports New Zealand research which indicates that dietary protein concentration of between 16 and 18% may be optimum.

Table 1 shows a concentrate diet formulation for a production Wapiti stag *(Malu)* in China (Liang et al 1993). Diets like this are often the result of local availability, and may overstate the requirements for protein feeds. Roughages including ensiled corn, tree leaves, podded plants, forage grasses and roots and melons fed first and complemented by fermented, steamed or expanded concentrates to improve feed conversion efficiency and balance the cost of grains and roughage sources. (Gao et al. 1996).

Table 1. Concentrate diet formulation for Wapiti stags in China.

Growth phase	Soybean cake (kg)	Maize (kg)	Bran (kg)	Distillers grain(kg)	ME intake (MJ/day)	Dry Matter intake (kg/d)	Diet energy density MJME/kg
Pre antler	1.0	0.5	0.7	1.5	45	3.7	12.1
Antler	1.45	0.7	1.1	1.5	58	4.75	12.2
Rutting	0.8	0.45	0.65	-	23	1.9	12.1
Recovery	0.95	0.45	0.65	1.25	40	3.3	12.1

While additional protein has not improved the velvet production of well-fed stags, it is important to remember what that means. Often stags in New Zealand are fed on silage during the winter and well into the spring. Silage is a product that has already been fermented and this means that although crude protein concentration may look adequate, often the digestion process does not yield enough protein to meet the stags' requirement. This is especially important in early spring when antler growth is initiated around button drop.

Moving to specialist silages that are based around legumes and chicory can help increase the true protein supply to the animal. Today, practically this is being surpassed by the use of fodder beets, swedes. Palm Kernel Expeller and new formulations of proprietary processed feed nuts, although there have been no formal velvet growth trials with controls reported as we understand it.

In recent years the basic winter forage diet for the AgResearch Invermay herd of mixed age stags on grass pasture baleage (or silage) was changed to a specific crop baleage fed ad lib for the winter and pre casting period in combination with 1.2kg of whole grain barley

With both red clover and lucerne sources, wastage was almost nil in comparison with pasture silage. Velvet weights average 4.07kg compared with 3.78kg the previous year.

After button drop the stag needs a diet that is well balanced to provide enough energy and protein to ensure good velvet growth. Often spring pasture is fine for this period, but it has to be remembered that the stag needs enough at this time. The pasture needs to be of good length and unsoiled.

This period begins in early August. Often stags are still on pasture silage through August and this will mean that the added protein requirement will not be adequately met. On a commercial farm the recognition of this factor has been documented to improve velvet weight by approximately 0.5 kg/head (Thayer 2002) when the system was changed from silage until September to stags going onto good quality (1800-2000kg /DM) pasture in early August.

A final factor in velvet growth is the mineral intake of the stag. Little research has been done to verify the concentrations of minerals in the diet. Some Chinese research with Sika deer suggests that the dietary concentration of calcium and phosphorus be 0.89 and 0.52% of the diet respectively for maximum velvet antler growth (Wang *et al.* 1997). Ca and P levels in the diet had effects on Ca contents in antler serum at the antler-harvesting stage, but no effects on P contents. However, much of the calcium and phosphorus required comes from remodelling of the stags bones and so the supply of more calcium has little overall effect on velvet weight. The amounts of other minerals that are essential for cell proliferation, such as copper and zinc, have not been specifically investigated although the role of adequate copper levels at least has been considered very important.

Management factors also play an important role in optimising production. The key to advancing velvet growth is in the 3 to 4 week post rut recovery period and in the pre casting period. Beneficial nutrition effects are enhanced by forming stable cohorts of similarly aged stags from as early as yearling age and to avoid adding in new animals or mixing groups.

During the rut, non breeding stag groups should be located with as much space as sensible feed conservation allows and as far from active breeding groups as is practical to reduce fence pacing, aggressive behaviour and extreme rut-related weight loss. Rapid post rut recovery with targeted feeding is readily achieved. Concentrates should be offered on an individual animal basis rather than by group feeding in troughs or lines. Bulky forages must be of the highest quality possible to counteract the rumen fill limitations to intake.

What else should we consider?

We know that velvet weight can vary significantly from year to year (Garrick 2001), and can be different from farm to farm, using similar genetics. What might be driving these variations in the expression of genetics?

Recent research from Spain considers the role of growing the stag calf in expressing antler growth (Gomez et al 2006). They suggest that the lactational performance of the hind, and hence the growth rate of the calf to weaning, will influence later pedicle development and antler growth. Calves well fed during this period initiated pedicles 5

days earlier and grew more antler than calves with slower growth rates. This was particularly related to the amount of protein in the milk.

Chinese experience also points to a high protein requirement during the first year of life. Gao et al (2003) summarised those experiences (Table 2) and concluded that protein was most important during the first antler growing cycle, recommending a diet containing 24.5% crude protein. During the second year the requirement reduced to 19%, and then to 15.5% for adults.

Table 2 The conversion of digestible crude protein requirements into crude protein requirements for New Zealand pasture feeding conditions (from Gao et al 2003).

			Protein requirements	
Stock class		Period	% CP [1]	% CP [2]
Calf		Post-weaning	28.0	16.5
Male				
	Yearling	Winter	18.0	11.5
		Antler growing	22.4	24.5
	2-3 year old	Winter		9.0
		Antler growing	19.0	19.0
	Mature	Winter		10.5
		Antler growing	17.0	15.5

[1] Crude protein requirements of reported Chinese diets

[2] Crude protein requirements assuming a digestibility of 0.75 for pasture

These studies highlight the impact of growth and nutrition before the stag begins to develop antler. This process of early nutritional ‘priming’ of future production potential has been measured almost to the beginning of foetal development. This means that the nutritional conditions that the foetus is subject to during the pregnancy of the hind may impact on the expression of genetic potential later in life.

What else might we have to be aware of when trying to maximise the potential of our genetics? The Spanish researchers have investigated mineral nutrition to some extent, but mainly in regard to the final strength of the antler once hard, rather than influencing velvet production. Probably of most significance is their work on the impact of late winter frosting on antler growth and strength (Landete-Castillejos et al 2010). The occurrence of significant late winter frosting (mean minimum temperatures of -2.4 and -2.3°C in July and August) appeared to promote an increase in silica in the feed available with an associated reduction on manganese. This reduction in manganese was associated with reduced antler weight and strength. They conclude by suggesting that the manganese is required very early in the development of the antler to provide a framework on which the calcium then develops. While these conditions may not be prevalent in New Zealand in many environments, they may have some effect in places like Central Otago and the central North Island.

What may be more important is the role of adequate manganese nutrition during casting and early velvet growth. The actual requirement for Mn in velveting stags is unknown, though the recommendation for rapidly growing poultry is 60 mg/kg DM, while for sheep and beef it is >20 mg/kg DM (Underwood and Suttle 1999). With the very rapid development of the velvet antler the requirement may be more closely aligned to that of poultry than other ruminants.

New Zealand pastures are often more than adequate in manganese (Mn) averaging approximately 160 and 180 mg Mn/kg DM in the North and South Islands (Smith and Edmeades 1983). However, increasing pH using lime can reduce this significantly with Mn levels in pasture being reduced to below 30 mg/kg DM in early spring when liming increased soil pH to 6.4 (Edmeades et al 1983).

This area of nutrition needs research in New Zealand to determine appropriate levels.

Conclusions

Maximising the genetic potential of velvet stags starts with good nutrition of the pregnant hind. This sets the future response to nutrition. Achieving a good weaning weight of the stag calves through feeding the hinds well will then begin to express that potential. As the stag approaches pedicle initiation the protein content of the diet needs to be relatively high and is best achieved on high quality pastures. Every spring from just before casting the stags should be gaining weight as quickly as they can on a well balanced diet, with younger stags getting diets that have a good protein content. Strategic supplementary feeding is critical to express the genetic potential for velvet production and can be supplied in a increasing variety of hard feeds, fodder v crops and high ME and high protein based conserved forages in the key post rut and pre-casting seasonal cycles.

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