THE NUTRITION OF FARMED DEER - A REVIEW

By K.R. Drew, Ag Research, Invermay Agricultural Centre, Private Bag 50034, Mosgiel, New Zealand.

Presented to the RIRDC Consensus Development Symposium Nutrition R & D for Farmed Deer in Melbourne on 1 March, 1997. This article has been reproduced with his kind permission.

The fundamentals of any livestock operation are feeding and breeding, and it is often said that 80% of the breeding component goes down the throat. The farming of deer is a livestock industry built on appropriate feeding. Deer like all other animals require energy, protein and minerals for maintenance, growth and lactation. Pastures, with the notable exception of dry summer conditions, contain 12-25% protein in the dry matter where maintenance in deer indicates 8-10% is adequate and about 16% is necessary for growth. Plant proteins are known to be 75-85% digested (Waghorn & Barry, 1987). Mineral requirement for deer is a complicated field but in broad terms requirements are similar to those in sheep and cattle. A notable exception is copper nutrition where there is evidence that deer require more than other livestock and elk/wapiti have a greater requirement than red or fallow deer. By far the most important nutrient for deer, which are very seasonal animals, is energy and this is the main topic to be addressed. Digestible energy or metabolizable energy (ME) is very variable among feeds and meeting the ME requirements is the most important nutritional objective.

The Australian deer industry is based on temperate deer species (red and fallow) and from a 1996 base of about 230,000 animals on 1,500 farms you are looking to increase by 50% over the next four years. For this to be successful, it is critical that the nutritional requirements of your deer are known and met. Inadequate nutrition will be shown in reduced reproductive rate and a failure to reach target growth rates for venison and velvet production.

Overview of seasonal growth in temperate deer.

The seasonal pattern of growth in deer is shown for males in Figure 1. It is clear that autumn/winter is a low growth period and growth rate is high in spring/summer. Females do not show the same degree of fluctuation by season and do not lose major weight during the rut. During the naturally low feed intake phase no matter how high the quality and quantity of the feed, energy intake will be low.

The establishment of N.Z. deer feeding standards.

Metabolizable energy (ME) is the best system for evaluating feed quality and establishing feed requirements. Gross energy of feed dry matter minus faecal energy, urine energy and gaseous energy (methane) gives ME which is expressed in mega joules (MJ). New Zealand deer feed requirement standards were initially determined by measuring liveweight gain and ME intake in individually pen fed stags thoughout the year and for groups of mature stags outdoors over winter (Fennessy *et al*, 1981). The annual and seasonal feed requirements were found to be a function of liveweight with due allowance for the following:

*Autumn = 65 days; the other three season = 100 days each.

*ME requirement for grazing deer is estimated to be 30,50,20 & 10% above that of indoor fed animals for autumn, winter, spring and summer respectively.

*ME allowance per kg LWG in stags and hinds = 37 MJ.

*ME allowance per kg LWG in suckling calves = 65 MJ.

*A small allowance has been made for velvet antler growth. The predicted seasonal feed ME requirement were compared with grazing experiments and farm records agreed well with estimated pasture growth and utilisation for young growing stags in spring and summer (Harbord, 1982).

Seasonal pasture quality.

Forage plants decrease in feeding value as they mature because the proportion of variably digested plant cell wall increases and the proportion of digested plant cell content decreases. Table 1 (from Waghorn & Barry, 1987) indicates that Italian Ryegrass increases in stem content from 18% to 64% over 12 weeks after cutting and the proportion of green leaf in the dry matter from 82% to 4% of DM in the same period. Green leaf digestibility of the ryegrass did not change much with time but digestibility of stem declined markedly 10-14 weeks after cutting. Practical pasture plant management should clearly aim at providing green leaf rather than stem. The ME value of DM (MJ ME/kg) is shown on Table 2 (Waghorn & Barry, 1987) to drop from 12 to under 9 as the plant goes from "young leafy" to seed setting.

Energy requirements of stags.

The dramatic seasonal changes in appetite, especially during the rut are shown in Fig. 2. There is an extremely low ad lib intake during the rut (up to 30% weight loss) and virtually maintenance on ad lib rations through the winter. Table 3 shows the seasonal ME requirements of four age groups of red stags. There is a high winter feed requirement in spite of no liveweight gain because the stags have lost almost all their fat over the rut, they are not well insulated and they have a basic high degree of heat loss when compared with traditional livestock. High spring feed requirements can easily be met from rapidly

growing high quality spring pasture but the mature stags which cast antler buttons in late winter may need a high quality supplement such as grain during the first 20-30 days of velvet growth. Failure to meet feed requirements during active velvet growth will decrease velvet yield.

Red deer in a sub-tropical environment have been shown to be less seasonal in their growth pattern than those in a temperate environment, with winter growth rate similar to summer growth (Woodford *et al,* 1990).

Energy requirements of hinds.
The focal point is lactation where feed requirements are more than double the other seasons. Table 4 shows the seasonal ME requirements of three age groups of red deer and the comparative requirements of ewes. The quality and quantity of available feed in the summer is critical for milk production and calf growth. The results of failure to provide high quality feed especially in late lactation can be seen in Scottish research (Table 5). The improved pasture when compared with heather as lactational forage 10-12 weeks after calving gave almost double the milk production and calf liveweight gain (Loudon & Milne, 1985). Differences were much less in early lactation. In non-irrigated dry summer areas of Australian poor lactation will be common unless high quality supplements such as maize or cereals are fed.

Hinds commonly do not lose weight over the rut and therefore enter the winter in good condition. That means that their feed requirements in winter are not greatly different than those of autumn and spring.

Feed requirements for maintenance and growth.
To maintain body weight the feed required goes up by 70% when the weight is doubled. Table 6 shows requirements for growth over a wide range of bodyweights.

Feed requirements for fallow deer.
Critical feeding trials to establish standards for fallow deer have not been done but Asher (1992) has made some ME estimates for several classes of fallow deer over the four seasons. The estimates are shown in Table 7. Breeding does are shown to have a greatly increased feed requirement during lactation in the summer. The bucks during the rut will fail to consume their autumn requirement and can lose up to 430g/d over a 30 day period.

Nutritional requirements of different genotypes.
In the Cervus elaphus group, there are a large range in genotypes from the small Scottish red deer to the very large N. American Elk. The European red deer and Elk are now beginning to play a major part in the N.Z. deer industry and the same is probably happening in Australia. The European reds are improving the base breeding herds and of course the mature body size is increasing. The Elk and hybrid stags are now widely used as terminal sires, leaving heavy fast-growing hybrid progeny that achieve good market weight at under one year of age. Table 8 from Drew (1996) gives the ME requirements for a range of weaner male genotypes. The words Elk and Wapiti are used interchangeably and it can be seen that although large genotypes have high feed requirements it is less than proportional to bodyweight differences. The real advantage in using a terminal sire in terms of efficiency is that the feeding of the breeding hinds is the same whatever the sire while the progeny are heavy and grow fast.

If feed requirements are known, how are they met?
1. Target liveweights
It is very helpful to have information that documents potential growth rate in a known genotype when feed quality and quantity are not limiting. Farm performance can then be measured against potential. Work by Suttie *et al* (1992) has shown the N.Z. red deer when fed an ad lib pelleted ration of lucerne hay/barley mixture (ME = 11.6; Protein = 16%) can reach 65kg at the end of winter and 120 kg at 15 months of age (end of February). Maximum food intake in the yearlings was 3 kg DM/h/day in mid November. Many deer farmers in New Zealand and probably in Australia fall a long way short of the potential weight/age figures. Genotype is important in relation to target weight achievement. Some years ago a study was done in New Zealand to compare performance of progeny (two properties) out of N.Z. red hinds sired by a range of N.Z. and European red sires. Table 9 gives some of the production levels achieved. Weaning weights x sires ranged from 55 to 62 kg but 15 month weights between 102 and 108 kg were disapppointing and suggest that yearling summer nutrition was inadequate. Research with red deer in Queensland established that 15 month old red stags can achieve weights of 101-107 kg which is close to the New Zealand target weight. The Queensland deer showed less seasonal variation in growth rate than red deer in a temperate climate (Woodford *et al,* 1990).

Practical target weights for red, wapiti and hybrids are shown in table 10. These weights should be serious targets for deer farmers with comparable figures derived for fallow deer. They are average figures and by definition half will be above and half below. The skill in deer farming is to minimise the spread as well as achieving the target. If targets are not being met then it is necessary to determine which season(s) is (are) the problem and change the feeding/management. Progeny from red hinds sired by a 1/2 wapiti bull (1/4 wapiti) will fall half way between the first two columns in Table 10 and it is obvious that 1/4 wapiti yearling females will easily achieve a target weight of more that 92 kg (less

than 50 kg carcass weight) something which very few red yearling females will achieve.

2. Pasture plant preferences

Red and fallow deer have been shown to have clear preferences for some forage plants ahead of others (Hunt & Hay, 1989). Sixteen grasses, herbs and legumes were sown in a grid pattern and preferences recorded by remote camera using lactating red hinds, yearling red stags and fallow deer. Lactating red hinds had a clear preference for low oestrogen red clover (twice any other species) ahead of lotus, chicory, white clover and sheeps burnet. Grasses were least preferred. Yearling red deer had a top preference for chicory ahead of the other non-grass forages. Fallow did not show the distinct red deer preference for legumes and herbs over grasses and in particular did not show the red deer's high preference for chicory. Fallow deer showed a marked preference for timothy and prairie grass which was not observed for red deer. Anecdotal evidence now suggests that farmers who graze their deer on 'preferred species' record improved animal growth rates.

3. Pasture allowance

A real problem for farmers is to estimate how much feed deer can obtain from pasture. One approach is to estimate the standing dry matter in kg DM/ha or in pasture height. Another approach is to estimate the residue left after a period of grazing before moving the deer to fresh pasture. Figure 3 (Fennessy & Milligan, 1987) demonstrates the change in liveweight gain or % total DM intake from pasture when pasture allowance (kg DM/h/d) or post-grazing pasture mass (kg green DM/ha) are varied. When the post-grazing mass is less that 1200 kg DM/ha then a small reduction in pasture "residual DM" means a large reduction in %DM intake from pasture. The approach of using pasture height as a determinant in liveweight gain has been used by Barry *et al* (1993). Almost half of young red deer stags grazing pasture which did not fall below 10cm in height during winter and spring attained 92 kg liveweight or more by 12 months of age while no animals grazing 5 cm pasture achieved that weight at one year of age. Hamilton *et al* (1995) grazed yearling red stags on 4,6,8 or 10 cm swards over summer in Scotland and concluded that sward height should be at least 6 cm in order to maximise liveweight gains, but also concluded that increasing sward height about 6cm is unlikely to improve individual animal performance. Optimum sward height may be close to 8 cm to achieve maximum output/ha.

Transferring information and technology.

There is often a gap between research knowledge and practical application. This may be because the 'boffins' have been impractical or because there has not been a good system in place for transferring information. Two examples of problems and solutions will be examined.

1. Meeting winter feed requirements of stags: Early in the N.Z. deer industry, there was a view that since stags in winter did not seem to grow even in the midst of plenty they hardly needed to eat at all! The consequence was a high winter mortality rate. Research found that winter feed requirements were high and that many farmers were feeding at about 1/2 maintenance. Within two years, through media articles and well attended field days, the winter feed requirement message was received, put into effect and mortality dropped. The success of this programme was partly because it is relatively easy to measure winter feed eaten on-farm because it is mainly hay, silage and grain.

2. Meeting summer feed requirements of hinds: Feed requirements are known but feeding status on the farm is difficult to quantify. Measuring available green DM can and is being done but there must be good forward planning using drought resistant plant species to allow improvement. The last six weeks pre-weaning in mid summer is the most difficult time and farmers can be made aware of inadequate nutrition by carefully weighing a proportion of six week old calves on their mothers. When weaning weights are available, the mid summer growth rate can be calculated and a good educational point made for the following year's management.

Nutritional questions for the Australian Deer Industry.

1. Do you have adequate feed requirement tables? This is particularly relevant to fallow deer. The New Zealand red deer information should be able to be used in Victoria and New South Wales but may not be appropriate in Queensland.
2. Do you know the genetic potential for growth in your red and fallow deer in your different environments? If not, then some research using a high quality pelleted feed would be valuable.
3. What is the weight for age performance of Australian deer? If there are wide gaps from potential performance then R & D priorities should focus on problem areas.
4. Protein nutrition may be important especially in Queensland. Do you need nitrogen supplementation for lactating hinds and yearling deer in summer? Can you use urea supplements?
5. Are progeny from terminal sires fed sufficient high quality feed to reach their potential growth? Feed requirement information is available from New Zealand but you may need to document actual performance in differing environments.
6. Do you know preferred forage species for red and fallow deer in Australia? Evaluation of practical options would be valuable.

Conclusions.

*Invest in nutritional fundamentals for deer in your environment and measure performance against potential when setting future R & D priorities.

*Grazing management systems and forage species evaluations which are targeted at documented problem areas will give a good return on investment.

*When planning nutritional R & D include a package about field application.

*There needs to be a clear return on the investment in improved nutrition eg. more calves; better carcass weights; less loss from disease.

References

Asher, G.W. 1992. Growth and nutrition of fallow deer. In "Progressive Fallow Deer Farming" 2nd edition (eds. Asher, G.W. & Langridge, M.); Ruakura Agricultural Centre. Pp59-67.

Barry, T.N., Wilson, P.R., Hodgson, J and Kusmartons. 1993. Development of special purpose forage systems for deer production. Proc. Deer Course for Veterinarians. 10: 176-182.

Drew, K.R. 1996 Deer nutrition requirement. Proc. Deer Course for Veterinarians. 13: 97-102.

Fennessy, P.F., Moore, G.H. and Corson, I.D. 1981 Proc. N.Z. Society of Anim Prod. 41: 111-118.

Fennessy, P.R. & Milligan, K.E. 1987 Grazing management of red deer. In "Livestock Feeding on Pasture" (ed. Nicol, A.M.). N.Z. Society Anim. Production. occ. publ. 10: 111-118.

Hamiliton, W.J., Sibbald, M.A. and Fiest, D. 1995. The effect of sward height on the liveweight gain of farmed yearling red deer (Cervus elaphus) stags. Grass and Forage Science. 50: 399-44.

Harbord, M. 1982. The Deer Farmer. 13: 27-30.

Hunt, W.F. & Hay, R.J.M. 1989. Alternative pasture species for deer production in the Waikato. Proc. Ruakura Farmers Conference. pp 31-33.

Loudon, A.S.I. & Milne, J.A. 1985. in "Biology of Deer Production" (eds. Fennessy, P.F. & Drew, K.R.). Royal Society of N.Z. Bull. 22:423-427.

Suttie, J.M.S., Corson, I.D., Webster, J.R. & Woodford, K.B. 1992. Photoperiodism & growth. Proc. Deer Course for Veterinarians. 9:136-142.

Waghorn, G.C. & Barry, T.N. 1987. Pature as a nutrient source. In "Livestock Feeding on Pasture" (ed Nicol, A.M.). N.Z. Society Anim. Prod. occ. Publ. 10: 21-37.

Woodford, K.B., Dunning, A. & Winch, J.B. 1990. Production of red deer in sub-tropical environment. Proc. Aust. Soc. Anim. Prod. 18: 436-439.

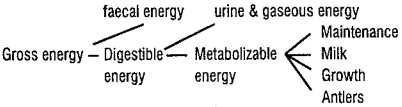
Protein

- Provide enough but excess is expensive
- 75-85% plant proteins are digested
- Growing animal (first year) - 16% in ration
- Maintenance and winter – 8-10% in ration
- Most NZ pastures 12-25% protein

Minerals

- Requirements broadly similar to sheep/cattle
- But copper is a special case where requirements thought to be higher than sheep/cattle
  – Wapiti type have high Cu requirements.

Feed energy available to deer



Derivation of practical feed requirements (Fennessy et al 1981)

A function of liveweight with due allowance for:

- Autumn = 65 days; other three seasons = 100 days each.
- Grazing deer need 30, 50, 20 and 10% more feed than indoor pen fed deer in autumn, winter, spring and summer respectively.
- ME allowance/kg LWG (stags and hinds) = 37 MJ.
- ME allowance/kg LWG (suckling calves) = 65 MJ.
- Small allowance for spring velvet antler growth.

Table 1. ME change as plants grow - Italian Ryegrass

	Weeks after cutting				
	2	4	6	10	14
DM Distribution (%)					
green leaf	82	63	37	15	4
stem	18	37	57	67	64
DM Digestibility (%)					
green stem	64	66	65	65	58
stem	64	68	63	59	49
ME - whole plant MJ/kg DM	12.0	11.5	11.0	10.1	9.2

(from Waghorn & Barry, 1987)

Tabel 2. Decline in perennial ryegrass digestibility with stage of growth

	ME value (MJ/kg Dm)
Young leafy	12.0
Late leafy	10.8
Head emergence	10.9
Seed setting	8.9

(from Waghorn & Barry, 1987)

Table 3. Seasonal feed requirements of NZ red stags

MJ ME/day

	Autumn	Winter	Spring	Summer	Av. Stock units
Rising 1 year	16	21	27	26	1.5
Rising 2 year	24	28	31	30	1.8
Rising 3 year	24	33	38	36	2.2
Mature	19	35	42	38	2.3

(from Fennesy et at, 1981)

Table 4. Seasonal feed requirements of NZ red hinds

MJ ME/day

	Autumn	Winter	Spring	Summer	Av. Stock units
Rising 1 year	15	17	22	21	1.2
Rising 2 year	20	23	23	45	1.8
> 2 year	23	22	24	47	1.9
Ewes	13	10	28	11	1.0

(from Fennessy et al, 1981)

Table 5. Feed Quality and Deer Milk Production

	Milk Yield (kg/d)		Calf Growth Rate (g/d)	
Stage of lactation (d)	Heath	Improved pasture	Heather	Improved pasture
0-20	1.6	1.9	370	400
40-6-	1.3	1.9	260	360
80-100	0.7	1.2	185	350

(from Loudon & Milne, 1985)

Table 6. Feed requirements for maintenance & growth

MJ ME/day

	Liveweight (kg)				
Gain (g/d)	40	60	80	100	160
Stags					
0	13	18	23	27	38
100	17	22	26	30	42
300	30	35	30	34	46
400	28	33	38	41	53
Hinds					
0	13	18	23	28	38
100	19	24	29	33	44
200	24	29	34	38	49
300	30	35	40	44	55

Table 7. Calculated energy requirements of fallow deer (MJ ME/day)

	Season				
	Autumn Liveweight	Autumn 100 days	Winter 65 days	Spring 100 days	Summer 100 days
Young bucks					
0.25 to 1.25 yr	20kg	11.0	11.8	14.2	13.0
1.25 to 2.25 yr	47kg	13.3	15.4	16.0	15.0
Sire bucks					
2 yr	65kg	17.0	16.1	18.1	18.1
3 yr	85kg	20.7	19.6	20.3	20.3
4+ yr	105kg	24.3	23.0	24.1	24.1
Young does					
0.25 to 1.25yr	18kg	9.7	10.4	11.3	11.3
1.25 to 2.25 yr	38kg	11.3	13.1	15.2	20.7
Breeding does	45kg	12.9	13.9	15.8	21.6
	55kg	15.0	16.1	17.5	23.4

(From Ahser, 1992)

Table 8. Feed requirements x deer genotype (weaner males)

	Liveweights (kg)	Autumn growth rate (g/d)	MJ ME/d	Relative feed requirment
Weaning (pre-rut)				
Typical NZ Red (NZR)	49	150	21	100
½ Wapiti / ½ NZR	74	200	29	138
¼ Wapiti / 3/4 NZR	57	175	25	119
Eld/Wapiti in Canada	120	250	40	190
¼ German / 3/4 NZR	58	170	24	114

(From Drew, 1996)

Table 9. European & NZ red sires

Industry red sire evaluation project tested 10 English, Hungarian and Yugoslavian sires over NZ red hinds in both islands.

Results

	Weaning weight (kg)	15mo weight (kg)
Tope sire	62	108
Average	59	104
Bottom sire	55	102

Table 10

	Target weights for stags (kg)		
	N.Z. Red	½-bred Wapiti/Red (F1)	Canadian Wapiti
4 months (weaning)	53	75	140
9 months (end weaning)	67	107	168
16 months (end summer)	109	160	260
2 years of age	145	180	320
Mature (summer)	200	300	400

	Target weights for hinds (kg)		
	N.Z. Red	½-bred Wapiti/Red (F1)	Canadian Wapiti
4 months (weaning)	48	66	120
9 months (weaning)	60	95	150
16 months (end summer)	85	130	220
2 years of age	95	180	270
Mature (summer)	100	220	330

Figure 1

Liveweight pattern for red deer stags

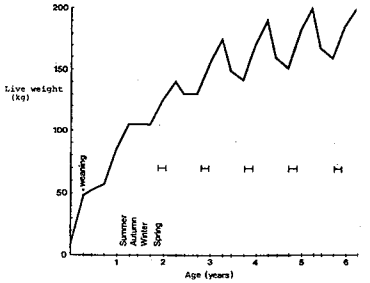


Figure 2

Pattern of feed intake and weight gain in 2½-3½ year old red stags fed a high quality pelleted ad lib diet indoors (Fennessy & Milligan, 1987)