Growth responses in red deer calves and hinds grazing red clover, chicory or perennial ryegrass/white clover swards during lactation

J. H. NIEZEN*, T. N. BARRY, J. HODGSON, P. R. WILSON, A. M. ATAJA, W. J. PARKER AND C. W. HOLMES

Massey University, Palmerston North, New Zealand

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SUMMARY

Two experiments were conducted at the Massey University Deer Unit, New Zealand in 1990 and 1991 to evaluate the performance of lactating red deer hinds and their calves grazing conventional perennial ryegrass-based pastures, red clover or chicory. In both experiments, hind and calf performance was evaluated from 1 month post-parturition over a $2\frac{1}{2}$ month summer period to weaning at $3\frac{1}{2}$ months of age.

In Expt 1, hinds and calves were grazed on low (5·4 kg dry matter (DM)/hd/day), medium (10·8) or high (16·4) allowances of red clover, or on a medium allowance of a conventional ryegrass/white clover sward (9·9 DM/hd/day). In Expt 2, hinds and calves grazed equal DM allowances (12 kg DM/hd/day) of perennial ryegrass/white clover, chicory or red clover.

Red clover generally had higher organic matter digestibility (OMD) and higher total N than ryegrass/white clover, and when grazed at equal DM allowances, promoted higher voluntary food intake in the hinds, increased calf growth (430 *v.* 330 g/day) and increased hind liveweight change. Although decreasing the red clover allowance in Expt 1 slightly but non-significantly decreased hind voluntary food intake and decreased both calf and hind liveweight change, all low red clover values were still consistently higher than all ryegrass/white clover values ($P < 0.05$). In Expt 2, chicory was of higher OMD and ash content than red clover but N content was lower and similar to ryegrass/white clover. Chicory promoted lower levels of calf liveweight change than red clover but higher than ryegrass/white clover. Hind liveweight change on chicory was lower than on red clover and was similar to ryegrass/white clover. It was concluded that red clover offers potential as a special purpose forage for deer production and that further experimental work is needed with chicory.

INTRODUCTION

Under conventional pastoral farming conditions in New Zealand (NZ), the nutrient requirements of red deer (*Cervus elaphus*) hinds and calves coincide poorly with the seasonal pattern of production by perennial ryegrass/white clover pastures. Hinds calve during late spring–early summer (November–December), by which time the ryegrass herbage is becoming mature, of reduced nutritive value and available dry matter is decreasing due to moisture stress (Adam 1988). This causes undernutrition of the lactating hinds, and calves do not achieve their genetic potential for growth from birth to weaning, during the period when young deer demonstrate the greatest potential growth rates in both relative and absolute terms.

Loudon *et al.* (1984) showed that grazing lactating hinds on improved pastures, based on perennial ryegrass, increased both hind milk yield and fawn weaning weight when compared with those grazing on unimproved Scottish pasture, based on heather. Adam & Moir (1987) did not find any difference in the growth rates of early-born and late-born calves on predominantly ryegrass pastures, but hinds lost more weight if they were late calvers.

In a series of grazing preference trials undertaken in NZ, red deer preferred red clover (*Trifolium pratense* L.) and chicory (*Cichorium intybus*) to most other pasture plant species (Hunt & Hay 1989). Perennial ryegrass (*Lolium perenne*), the basis of most conventional lowland NZ pastures, was least preferred by

* Present address: AgResearch, Flock House Agricultural Centre, Bulls 5452, New Zealand.

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red deer hinds. Both red clover and chicory have seasonal growth patterns which coincide more closely with the nutrient requirements of lactating hinds (i.e. high summer/autumn DM production: Lancashire & Brock 1983; R. J. M. Hay, unpublished), and have higher dry matter digestibilities than perennial ryegrass (Ulyatt 1981; Clark *et al.* 1990). Lambs grazed on red clover achieve higher organic matter (OM) intakes than on ryegrass (Hodgson 1975) and have higher growth rates (Ulyatt 1981). Very little information is available on animal production using chicory. Furthermore, no studies have been reported to determine whether deer grazed on preferred species demonstrate improved production responses.

The objectives of the present study were to compare growth responses of red deer hinds and calves during lactation when grazing equal allowances of red clover, chicory and perennial ryegrass/white clover, and to study responses to a range of allowances of red clover. Further objectives were to monitor any health problems, particularly rumen frothy bloat.

MATERIALS AND METHODS

Two experiments were conducted over consecutive years (1990 and 1991) at the Massey University Deer Research Unit, Palmerston North, NZ. The soils are a uniform type gley, yellow earth soil (Tokomaru silt loam clay) and of moderate fertility. Rainfall is reliable and averages 900–1200 mm annually. Temperature ranges between 19 and 23 °C during daytime and 9 to 13 °C at night during the summer months (Burgess 1988).

Experimental design

Lactating hinds plus their calves, born during the period early November to early December, were used in both experiments. In the first year (Expt 1), 32 lactating mixed age red deer hinds and their calves ($n = 8$/treatment) were grouped on calving date and calf sex and randomly assigned to a conventional perennial ryegrass/white clover pasture (CON) or one of three allowances (low (LC), medium (MC), or high (HC)) of a red clover sward. The treatments commenced on 29 December 1989 and concluded on 28 February 1990. Seven paddocks of ryegrass/white clover and five paddocks of red clover were used. The herbage allowance was maintained by estimating pre-grazing herbage mass and determining the grazing period required. The designated allowance on the ryegrass/white clover pasture was 12 kg DM/hd/day and on the red clover was 6, 12 or 18 kg DM/hd/day on the low, medium and high allowances respectively. The corresponding stocking rates were 7·1, 17·5, 8·7 and 5·8 hind/calf units/ha respectively.

In the second year (Expt 2), hinds were randomly allocated to red clover (RC), chicory (CHIC) or perennial ryegrass/white clover (CON) pasture ($n = 16$, $n = 15$ and $n = 12$ hinds respectively) before calving (mid-November). The designated allowance was 12 kg DM/hd/day on all three treatments. All of the hinds had calves born to them. The corresponding animal stocking rates were 7·0, 8·6 and 6·0 hind/calf pairs/ha respectively. The period of weighing was 7 January to 25 February 1991.

Animals

In both experiments the red deer hinds had been bred to one of two red deer stags the previous autumn. Both hinds and calves were weighed bi-weekly. In Expt 1 the records of one calf on the MC treatment were removed from the trial after it had contracted osteomyelitis. Prior to the onset of Expt 1, 24 hinds ($n = 6$/treatment) were administered with custom made, calf size slow release chromic oxide capsules (7 mm orifice, 25 mm barrel diameter, 96 mm length) (Captec NZ Ltd, Auckland NZ), in order to estimate voluntary OM intakes. Rectal faecal grab samples for chromium analysis were taken from the hinds given capsules in three periods of three collections every second day from day 10 to day 34.

Pastures

Red clover (cv. Pawera) was drilled at the rate of 8 kg/ha in early spring (1989) in Expt 1 over an area of 2·75 ha, divided into five equal sized paddocks. Prior to sowing, the area was sprayed with glyphosate (Roundup®, Monsanto) and after emergence of the red clover, the area was sprayed with bentazone (Basagran®, BASF) to control weed infestation. In the autumn of 1990, 1·75 ha of chicory (cv. Puna) was sown at a seeding rate of 8 kg/ha in four of the paddocks which were used in Expt 2. Single superphosphate fertilizer (9% P, 11% S) was applied to all paddocks of RC, CHIC and CON at 220 kg/ha during the autumn of 1989 and 1990. Urea (46% N) was applied to the chicory after each grazing at 100 kg/ha.

The designated herbage allowances on the red clover treatments were achieved by dividing each paddock in a ratio of 1:2:3 with semi-permanent and portable electric fences. The red clover paddocks were grazed following a 30-day rotation, with *c.* 6 days per paddock, depending on pre-grazing herbage mass (non experimental). Stags or cattle were utilized to graze out the uneven herbage residue left after grazing by the hinds and calves.

Seven paddocks (0·5 ha) of perennial ryegrass (cv. Grasslands Ruanui) and white clover (cv. Grasslands Huia) were used for the CON treatment in Expt 1, while four were used in Expt 2. Each paddock was grazed for 6–9 days before animals were shifted in a rotation depending on the pre-grazing herbage mass.

Table 1. (*Experiment 1*) *Pre-grazing and post-grazing herbage mass and daily dry matter allowance of grazing, lactating red deer hinds and calves on each of three allowances of red clover: high (HC), medium (MC) or low (LC) or perennial ryegrass/white clover (CON) pastures*

	Treatment				
	HC	MC	LC	CON	S.E.*
Pre-grazing herbage mass (kg DM/ha)	3420	3420	3420	3660	NA†
Post-grazing herbage mass (kg DM/ha)‡	1386	952	422	1274	107·1
DM offered (kg DM/hd/day)‡	16·4	10·8	5·4	9·9	1·01

* Standard error of the mean with at least 6 degrees of freedom (D.F.).
† Not applicable.
‡ Post-grazing herbage mass was measured in three quadrats/treatment/shift. There were 9 shifts on red and 7 on white clover. D.F. = 26 and 20 respectively. Dry matter offered was calculated per shift. D.F. = 8 and 6 respectively for red and white clover.

These paddocks had previously either been grazed by deer or had been used to make silage. The paddocks were selected on visual appraisal of the quantity and quality of feed available. Similar rotations were followed in Expt 2.

Herbage mass was measured pre- and post-grazing by cutting herbage to soil level on all paddocks before grazing using six (0·5 m^2) quadrats per paddock. Exclusion cages (0·5 × 1 m) were distributed through each treatment (n = 3/paddock grazed); following grazing, samples were taken from these areas corresponding to the diet selected by the grazing deer. Organic matter digestibility (OMD) was determined from these samples to calculate OM intake from chromium concentration in the faeces using the method of Parker *et al.* (1989). Samples of herbage were also cut to ground level when the deer were introduced to each paddock and retained for chemical analysis; these were defined as food on offer.

All herbage samples were freeze-dried and ground to pass through a 1 mm sieve. Total nitrogen concentration was determined using the Kjeldahl method. *In vitro* digestibility was determined using the enzymatic hydrolysis method of Roughan & Holland (1977). Faecal chromium concentration was determined by atomic absorption following the method of Parker *et al.* (1989).

Statistical methods and calculation of data

All analyses were undertaken using SAS GLM procedures (Statistics Institute 1985). Least square means for hind and fawn weight were compared. Weaning weights were adjusted for initial weights. Growth rate of the calves from birth to the onset of the trial was measured to be used as a covariate. However, the covariate was not significant, nor were any calf gender × treatment interactions and only main effects are presented. Metabolizable energy concentration in the herbage (MJ ME/kg OM) was calculated from the proportion of DOM in the OM × 16·3.

RESULTS

Pastures

Experiment 1

Pre- and post-grazing herbage mass and DM allowances for the four treatments are given in Table 1. Actual dry matter allowances were slightly lower than planned due to slight discrepancies between recorded and actual paddock size. On the HC treatment only leaves were grazed, on the MC treatment, leaves and lush stem and on the LC treatment, the entire plant.

Post-grazing herbage mass did not differ between the HC, MC and CON treatments and all were greater ($P < 0·05$) than the LC treatment. OMD, calculated ME values, N and ash levels of herbage offered and selected are given in Table 2. The red clover offered on all three allowances was higher ($P < 0·001$) in OMD, ME and N but not in ash concentration than CON. The OMD and ME content of the herbage selected by the animals was higher ($P < 0·0001$) for red clover than CON, while both OMD and ME were similar for HC and MC but greater than LC ($P < 0·01$). Herbage selected on the HC and MC treatments did not differ in N or ash concentration but both were greater ($P < 0·05$) than LC and CON, which were similar.

Experiment 2

In Expt 2 there was some white clover present in the RC paddocks (Table 3) which was not present in

Table 2. (*Experiment 1*) *Organic matter digestibility (OMD), calculated metabolizable energy (ME) concentration and total nitrogen and ash concentration of forages offered and selected by grazing, lactating red deer hinds on one of three allowances of red clover: high (HC), medium (MC) or low (LC) or perennial ryegrass/white clover pasture (CON)*

	Treatment				
	HC	MC	LC	CON	S.E.
OMD (%)					
Offered	80·5	80·5	80·5	73·1	0·65
Selected	82·9	82·0	79·7	72·1	0·57
Calculated ME (MJ/kg OM)					
Offered	13·1	13·1	13·1	11·9	0·39
Selected	13·5	13·4	13·0	11·8	0·20
Total N (%OM)					
Offered	3·69	3·69	3·69	2·83	0·187
Selected	4·47	4·34	3·58	3·50	0·162
Ash (%DM)					
Offered	28·0	28·0	28·0	27·3	4·43
Selected	10·9	15·5	18·1	14·4	1·86

Herbage samples were collected from each shift. Two, duplicate, analyses were made from each shift. D.F. = 8 and 6 respectively for red and white clover.

Table 3. (*Experiment 2*) *Botanical composition (mean ± S.E.; % DM) of chicory (CHIC), red clover (RC) or perennial ryegrass/white clover (CON) paddocks grazed (7 shifts) by lactating red deer hinds and calves until weaning.* D.F. = 6.

	Forage type		
Species	CHIC	RC	CON
Grass	5·9 ± 1·79	2·5 ± 1·57	62·7 ± 5·30
Red clover	—*	73·3 ± 3·48	—
Chicory	71·0 ± 7·74	—	—
White clover	0·7 ± 0·37	12·7 ± 2·36	10·0 ± 1·94
Weed species	16·6 ± 6·13	1·1 ± 0·67	0·6 ± 0·40
Dead matter	5·7 ± 3·44	10·3 ± 2·21	26·8 ± 4·55

* Non-detectable.

Table 4. (*Experiment 2*) *Mean values for nitrogen (N), organic matter digestibility (OMD), calculated ME values and ash levels of red clover (RC), chicory (CHIC) or perennial ryegrass/white clover (CON) paddocks grazed (7 shifts) by lactating red deer hinds and calves until weaning.* D.F. = 6.

	Treatment			
	RC	CHIC	CON	S.E.
Total N (%OM)	4·47	3·55	3·79	0·18
OMD (%)	80·4	84·8	78·2	0·63
ME (MJ/kgOM)	13·1	13·8	12·8	0·14
Ash (%DM)	11·1	16·4	11·0	0·75

Expt. 1. The high percentage of dead matter in CON is typical of perennial ryegrass-based pastures in NZ during the summer. The weed species present in CHIC reflect the open nature of typical chicory swards.

Results of chemical analyses of the RC, CHIC and CON swards (Table 4) show that CHIC had the highest values ($P < 0.0001$) for OMD, calculated ME and ash content but total N levels were similar to those of CON. RC had the highest N ($P < 0.001$), intermediate OMD and ME and had ash levels similar to CON.

Animals

Experiment 1

Calves were weaned at 93·9 ± 4·43 days of age (mean ± S.D.). Weaning weights, adjusted for initial weight, were highest for the HC and MC treatments ($P < 0.01$), lowest for CON ($P < 0.05$) and intermediate for LC (Table 5). Calf average daily gain (ADG) was also highest for the HC and MC treatments ($P < 0.01$), lowest for CON ($P < 0.05$) and intermediate for LC. Significant treatment differences first appeared after the third weighing when the calves were 60 days old (data not presented).

Differences between treatments in hind liveweight changes showed a similar pattern to calf liveweight

Table 5. (*Experiment 1*) *Weight changes of lactating red deer hinds and calves and organic matter intake (OMI) and metabolizable energy intake (MEI) of the hinds when grazing a high (HC), medium (MC), or low (LC) red clover allowance or perennial ryegrass/white clover (CON) sward*

	Treatment				
	HC	MC	LC	CON	S.E.
Hind weight change (g/hd/day)	53·3	58·3	5·3	−52·2	14·0
Calf weight gain (g/hd/day)	461·1	432·9	379·9	332·6	15·1
Calf weaning weight (kg)	51·3	49·5	46·7	42·8	0·92
OMI (g/kg $W^{0.75}$/day)	87·7	77·3	80·4	49·0	4·35
MEI MJ/kg $W^{0.75}$/day)	1·43	1·26	1·31	0·79	0·071

There were 8 hinds/treatment for 4 treatments. D.F. = 28.
There were 8 calves/treatment on the red and 7 calves on the single white treatment. D.F. = 27.
Six hinds/treatment were given chromium capsules.
The capsule was lost from one animal (D.F. = 20 − 1 = 19).

Table 6. (*Experiment 2*) *Average weight changes of lactating red deer hinds and calves to weaning when grazed on similar dry matter allowances of red clover (RC), chicory (CHIC) or perennial ryegrass/white clover (CON)*

	Treatment			
	RC	CHIC	CON	S.E.
Hind weight change (g/hd/day)	69·6	6·7	27·2	13·17
Fawn weight change (g/hd/day)	410	385	331	12·0
Fawn weaning weight (kg)	50·5	49·3	46·7	0·59

16, 15 and 12 hinds received the treatments (40 D.F.).

gain. Hinds on the MC and HC treatments had similar weight gains but both gained faster than hinds on the LC treatment ($P < 0.05$). Hinds on the CON treatment lost weight. Organic matter intake per unit metabolic body weight (OMI/kg $W^{0.75}$) and calculated metabolizable energy intakes (MEI $W^{0.75}$) showed a small and non-significant decline with decreasing allowance of red clover, but these were all significantly greater ($P < 0.01$) than the intake of hinds on the CON treatment.

Experiment 2

The growth rates and the weaning weight of calves tended to be greater on the RC than the CHIC treatment ($P < 0.07$), which was greater than the CON treatment ($P < 0.001$) (Table 6). Hinds on RC gained more weight than on CON ($P < 0.001$), which in turn tended to gain more weight than those on CHIC ($P < 0.09$).

Animal health

During the trial all animals were closely monitored for any potential health problems. Although lush red clover is known to cause bloat in cattle, it was not observed in the hinds or calves. No adverse health indications were noticed, but an occurrence of red urine was observed in deer on red clover in Expt 1 but not Expt 2 and has been reported elsewhere (Niezen *et al.* 1992).

DISCUSSION

The DM allowances on the CON treatment in both experiments were in accordance with the higher allowance of perennial ryegrass in the study of Loudon *et al.* (1984). Corresponding calf growth rates from 30 to 100 days of age in the present study are slightly lower than the results of Loudon *et al.* (1984) (333 *v.* 365 g/day respectively), but in general agree with other reports in the literature (Adam & Moir 1987) and local industry growth rates (P. R. Wilson, unpublished). The high proportion of dead matter and lower OMD show that the summer pastures used were of lower nutritive value than spring pastures. In Expt 1, the hinds on the CON treatment lost weight and in Expt 2 only slightly gained weight over the duration of the trial, indicating that the animals were in a marginal positive/negative energy balance. These results differ from the results of Loudon *et al.* (1984),

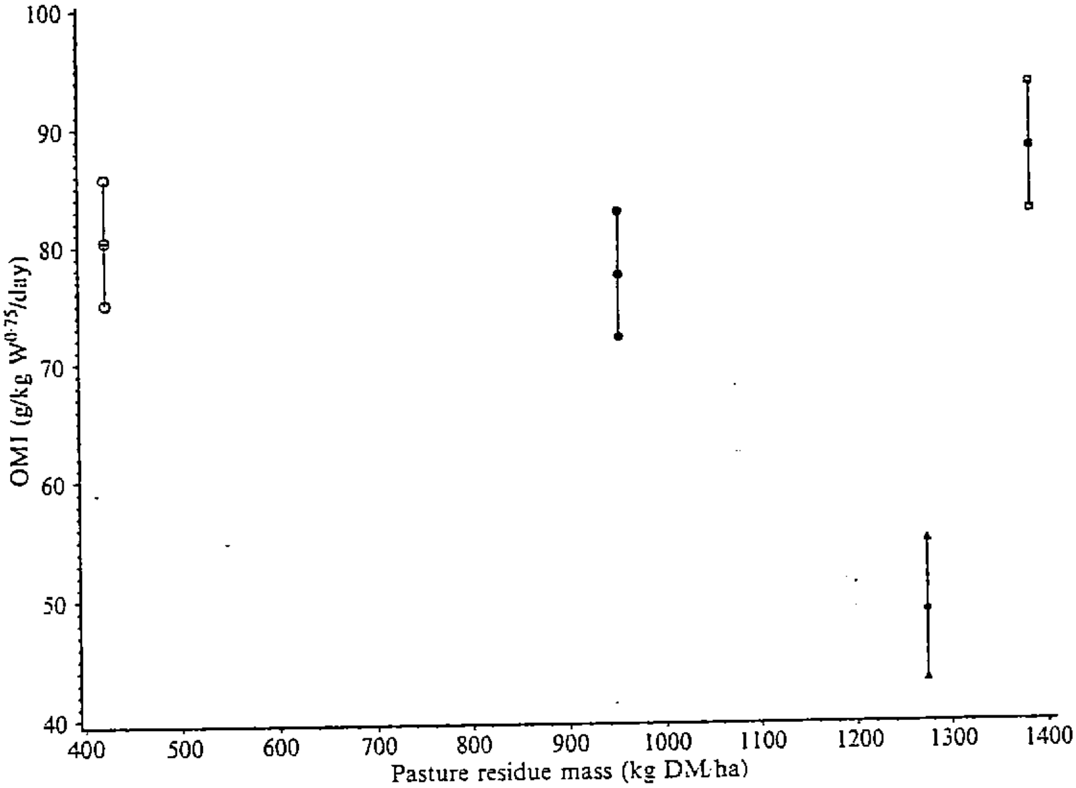

Fig. 1. Lactating red deer hind daily organic matter intake (OMI; g/kg $W^{0.75}$) and pasture residue mass (kg DM/ha) when grazing either one of three herbage allowances of red clover: high (HC □), medium (MC ●) and low (LC ○) or perennial ryegrass/white clover (CON △) in Expt 1.

where hinds on all three treatments gained weight from day 30 of the trial (equivalent to the onset of this trial) to day 100.

Relative to the perennial ryegrass-based pastures, the red clover used in both experiments was of higher OMD and total N and voluntary food intake (VFI) was higher. Hence grazing red clover promoted greater levels of deer production than grazing CON pastures, both in terms of calf and hind growth, with the advantage in calf growth being relatively constant (430 *v.* 330 g/day). Whilst decreasing red clover allowance (and decreasing post-grazing residual DM) produced decreases in hind VFI and calf liveweight gain (Table 5; Fig. 1), the rate of decline was relatively modest and all LC values were substantially higher than all CON values. These allowance *v.* productivity relationships support the hypothesis of Poppi *et al.* (1987) that red clover (as a legume) is of higher nutritive value to deer than CON pasture (based on perennial ryegrass), and that this higher animal performance on the legume can be sustained at lower allowances (and residual DM). It has been found that the basis of the superior OMD and VFI of deer fed red clover, compared to perennial ryegrass, is its more rapid rate of ruminal breakdown rather than a faster rumen outflow rate (D. O. Freudenberger, C. J. Burns, K. Toyokawa & T. N. Barry, unpublished). The absence of bloating in deer fed sole diets of red clover was very noticeable. Bloat is caused by the development of a stable foam from the high contents of soluble protein in some forages (Mangan 1959). Rumen fractional outflow rate of water is much higher in deer than in sheep and goats (16 *v.* 10%/h; Domingue *et al.* 1991) and the ratio of water outflow:particulate outflow is higher for deer fed red clover than those fed perennial ryegrass (D. O. Freudenberger, C. J. Burns, K. Toyokawa & T. N. Barry, unpublished). The absence of bloat in deer fed red clover may therefore be due to the very rapid rate of flow of water and soluble protein from the rumen into the lower intestinal tract.

The absolute values for VFI recorded in Expt 1 seem low, relative to published values for lactating hinds (Fennessy *et al.* 1981), which were extrapolated from an indoor feeding trial with stags fed a barley–lucerne–linseed pelleted diet. Possible reasons are an underestimation of chromium release rate using rumen fistulated castrate stags rather than non-fistulated lactating hinds, or an underestimation of OMD of the diet selected, using the hand-plucking technique. However, neither of these prevents valid comparisons being made between treatments in the same experiment.

The average growth of 450 g/day for red deer

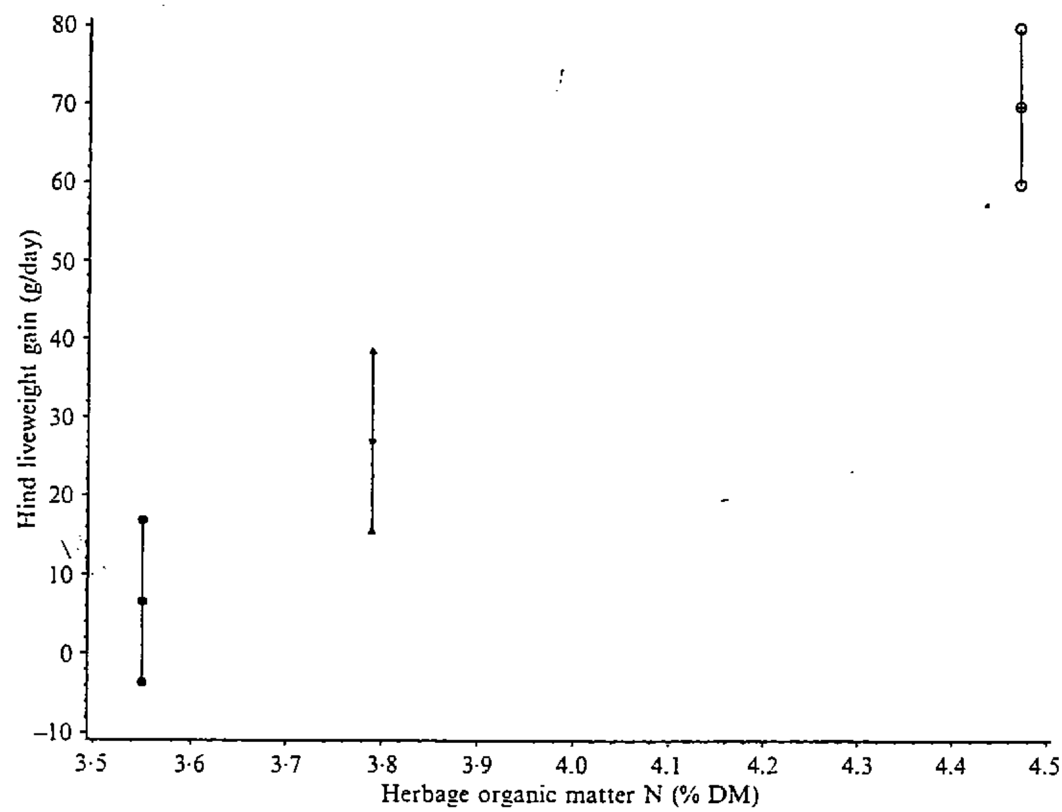

Fig. 2. Herbage organic matter N (% DM) and liveweight gain (g/day) of lactating red deer hinds grazing equal DM allowances of chicory (CHIC ●), red clover (RC ○) or ryegrass/white clover (CON △) in Expt 2.

calves on red clover from 30 to 100 days of age is *c.* 90–100 g/day greater than previously reported. Growth rates for pure wapiti (*Cervus elaphus canadensis*) calves can reach 870 g/day (Hudson & Adamczewski 1990). However, calf growth relative to dam metabolic body weight for wapiti is similar to red deer (14·2 *v.* 12·7 g day/kg dam liveweight$^{0·75}$). The influence of the wapiti genotype is the subject of further study.

In Expt 1, treatment differences did not become apparent until calves attained an age of 75 days (43 days on the trial) (data not presented). Loudon *et al.* (1984) reported treatment differences between 30 and 70 days on indigenous hill pasture or ryegrass and after 70 days on two allowances of ryegrass, suggesting that hind lactation performance may be decreasing and herbage ingestion in the calf increasing at this stage.

Red clover OMD, ME and N values were higher in year 2 than in year 1 and reflected the greater management flexibility in year 2 due to higher rainfall and having established swards, thus allowing the deer to graze the red clover at the optimum time. Climatic records indicate that there was unseasonably high rainfall in the summer that Expt 2 was undertaken (B. Campbell, personal communication). The slightly higher OMD values for herbage offered on the CON treatment in Expt 2 than Expt 1 is also a reflection of moister conditions. In Expt 2, hind weight changes did not follow the pattern of calf weight gain which occurred in Expt 1, with hinds on the CON treatment gaining weight slightly, reflecting the better quality of the sward available in Expt 2.

Adjusted organic matter intakes (OMI/kg hind liveweight$^{0·75}$) did not differ between the three clover allowances in Expt 1, but calf growth and hind weight change differed significantly between the LC and the MC and HC treatments. The pattern of hind weight change in Expt 2 most closely parallels N levels in the selected herbage (Fig. 2) and may indicate a deficiency of essential amino acids for lactating deer, as shown for lactating dairy cattle fed fresh ryegrass-based forages (Rogers *et al.* 1979, 1980). This needs further investigation.

Red clover allows red deer a much greater ability to utilize the available herbage mass more fully. Red clover is a more erect plant which may be more compatible with the deer's grazing behaviour as well as being more palatable. Sward height has been shown to be highly correlated with red deer bite volume and bite weight when grazing *Sorghum bicolor* (Mitchell *et al.* 1991), but the relationship across plants of differing physical structure has not been determined. The higher OMD and greater postruminal N digestion of red clover (Ulyatt *et al.* 1976) may be well suited to the digestive tract morphology of the red deer.

More careful grazing management of red clover and chicory than ryegrass/white clover is required. Deer will graze both plants to very low residue levels, which will affect the persistence of both species. For chicory, proper grazing management is essential to prevent the plant bolting to seedhead. This necessitates frequent hard grazing pressure which may compromise calf production. In this trial, seedheads were removed by mechanical means prior to grazing in order to ensure that only vegetative growth was on offer. However, the high OMD recorded in this study, plus the low concentration of condensed tannins found by Terrill *et al.* (1992), which should improve the efficiency of protein digestion, indicates that chicory is of high nutritive value when maintained in the vegetative state. Further work is needed on the management of chicory for deer production.

The hinds were removed from the red clover at weaning, 3 weeks before the onset of the rut. Subsequent fertility of the hinds was not affected (P. R. Wilson, personal communication) by grazing red clover during lactation, even though it was a variety high in formononetin content which has been shown to reduce fecundity in sheep (Kelly & Shackell 1982). Observations of fertility of yearling hinds born and raised on red clover indicate no subsequent interference with reproductive development.

These results have significance for the deer industry, as weaning weights of 50 kg in red deer can be attained by 3 months of age. Recent studies have confirmed that all red deer stags can attain 100 kg liveweight by 12 months of age through grazing red clover in the summer, autumn and late spring and proper winter grazing management on perennial ryegrass/white clover pastures (Semiadi *et al.* 1992). It is concluded that red clover offers potential as a special purpose forage for deer production, but that further experimental work is needed with chicory.

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