New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

You are free to:

Share— copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for commercial purposes.

NoDerivatives — If you remix, transform, or build upon the material, you may not distribute the modified material.

http://creativecommons.org.nz/licences/licences-explained/
Designing pastures for modern deer farming systems

S. MOLONEY
Forage Agronomist, Landcorp Farming Ltd

ABSTRACT

Following on from definitive measurements on deer preferences to pasture species by Hunt & Hay in the late 1980's, this paper provides some practical guidelines for how forage programmes can be set up in NZ deer farming systems. These programmes take into account the highly selective nature of NZ red deer, their strong preference for herbs and legumes well ahead of grasses. Three groups of pastures are put forward for use in integrated breeding and finishing deer systems. Group I are general purpose pastures, based on perennial grass species but include desirable herb and legume species. Within this group key selection criteria such as ryegrass heading date, endophyte type and ploidy level are discussed. Group II pastures are built around the high performance characteristics of hybrid ryegrasses including high soluble carbohydrate levels and cool-season yield, while still incorporating important legume and herb contributions. This group is considered strategically important in meeting the rapid growth demand of weaners in both the autumn and early-spring. Group III are specialist pastures based solely on herb and legume species. Collectively they are characterized by high animal VFI and performance, strong dietary preference by deer and winter dormancy. Their use for enhanced hind lactation and fawn growth rates, and mid-spring weaner growth is discussed. Pasture groups replacement rates, proportions within a whole farm system and some key establishment and management considerations are also addressed.

Keywords: pasture groups; species preferences; specialist forages; Chicorium intybus; renovation rotations; pasture replacement rates.

INTRODUCTION

Even before we began farming deer in New Zealand 30 years ago, we learned from experienced hunters how deer behaved as highly selective browsers with a preference for certain shrub and tree species (e.g. Griselinia; Pseudopanax). However, despite these early observations it is only recently that some of these principles are being applied to our forage systems on the modern deer farm.

In the late 1980's Hunt & Hay (1989, 1990) performed what I believe to be quite definitive experiments in objectively measuring the grazing preferences of deer, horses and dairy calves to a range of pasture species. These studies followed on from British researchers who deemed that the understanding of sheep and cattle’s pasture species preference was crucial to achieving full stability and utilization of pastures (Tribe & Gordon 1950, Ivins, 1955). They contended that this would have a marked effect on animal voluntary feed intake (VFI) and, in turn, animal performance.

As a former AgResearch Grasslands colleague at the time, Dr Warren Hunt was active in this work and his trial results had, and continue to have, a big influence on the way I approach the design of deer pastures, and associated renovation programmes, to fit various deer farming operations.

Deer farming systems in NZ offer unique nutritional challenges, as well as rewards, particularly in relation to getting the right match between the environment and pasture species. In this paper I would like to share with you some of my experiences and principles that we have learned from our Landcorp programmes over time.

Key point summary of Hunt & Hay (1989, 1990)

• A novel still photography technique was used to establish the pasture species preferences of deer from 16 different herb, legume and grass species.
• Trials consisted of four replicated blocks, with photos taken every 2 minutes during 3x 72 minute runs per day, in summer for hinds and autumn for stags.
• Results for lactating hinds showed a strong preference for red clover, twice that of the next preferred group which included chicory, lotus and white clover. The remaining legumes (lucerne, saffron and sula) were all well ahead of the grasses in preference ranking (Figure 1).
• Yearling red stags in autumn showed a similar preference pattern, although chicory and lotus were ranked well ahead of the next group of lucerne, white clover and red clover. Interestingly, the grasses, while still very low in preference relative to herbs and legumes, scored higher than for hinds. The most highly preferred grass species included prairie grass, tall fescue, hybrid ryegrass and, surprisingly, Kara cocksfoot.

Like most ruminant species, the deer reproductive cycle has a pronounced effect on the timing of feed demand. However, deer are relatively unique in their feed demand timeline. For lactating hinds peak demand occurs during the summer lactation (Figure 2) (47 MJME/kg DM) but halves during the winter maintenance period (22 MJME/kg DM). Here lies our first major challenge, in that most NZ pastures are ryegrass-based, and characterized by spring bulk and poor summer yield and quality.

Weaner hind and stags share a similar degree of inappetance and relatively poor liveweight gain (LWG) potential (150g/day at best) over the winter. However, on either side of this flat period (ie. in autumn and spring) there is an acute demand for feed mass and quality. In
Forage systems for deer farming

While there are many variations in NZ deer enterprises, including breeding, finishing, velvet and sire stag breeding, in this paper I will refer to self-contained operations combining both breeding and finishing operations, as this represents the majority of our Landcorp deer operations.

In Landcorp’s combined breeding and finishing enterprises, we provide for three main groups of pastures.

Group I: General purpose deer pastures (7-10 years duration)

These are grass species based but with a strong clover and herb inclusion. The grass species used will depend on environmental conditions such as climate, soil characteristics and topography. For example, in summer-dry environments (Milne & Moloney, 1993), on free-draining soils, there will be yield and quality advantages over ryegrass by using tall fescue (Moloney 1991) and brome species (e.g., Advance tall fescue (Festuca arundinacea) and Gala grazing brome (Bromus staminus)) often used successfully in combination. Deer showed a preference for both species ahead of perennial ryegrass (Hunt & Hay 1989). Red and white clover cultivars are highly compatible with tall fescue offering good quality even during its relatively late-heading phase. New cultivars, Charlton and Viking, both are achieving significantly higher stolon densities while are superior in yield relative to the old cultivar Kahu, as very small seed rates of 1.0 to 1.5 kg are more than adequate in a mixture.

In summer-moist regions, particularly on heavier poorer-drained soils, either full perennial ryegrass cultivars or long-term hybrids (e.g. Greenstone) will be used. There are important features to consider when selecting from the considerable range of perennial ryegrass cultivars commercially available. Flowering, or more correctly, heading date, is becoming increasingly important as the variation between cultivars increases. This ranges from the early types (e.g., Meridian at 17 days) to late types (e.g. Impact +21* and Quartet +28 days). Mid-heading cultivars, such as Nui and Bronsyn, head around the 20 October and are set at 0 days (* Impact is technically a long-term hybrid).

Early-heading types provide valuable additional yield through the cool-season (May to late-September). This can provide valuable mass when weaner appetite increases in mid-August. Late-heading cultivars offer good summer mass and quality, and in Grasslands Impact’s case, good cool-season activity through its small inclusion of Italian ryegrass in its parentage.

Other features include the ryegrass endophyte type, where because of deer susceptibility to ryegrass staggers (particularly amongst Elk and Wapiti), wild types need to be avoided. However, endophyte safe options like Endosafe Greenstone and, more recently AR1, should be used. In South Island summer moist regions, endofree or low endophyte options may be a possibility. A wide range of AR1 infected ryegrass cultivars are now coming on to the market, making this selection process considerably easier than the past.

Finally, it appears that, given a choice, deer will actively select against ryegrasses containing higher levels of structural carbohydrate (fibre) typical of diploid cultivars. Tetraploid cultivars, such as Quartet, Horizon and Greenstone have less fibre and increased levels of soluble carbohydrates (sugar, starch). These features combine to result in increased VFI and energy (MJME) per kg DM eaten, leading to increased animal performance, relative to diploid cultivars. They also tend to be lower in tiller density making them more compatible with clover and herb species. However, active selection pressure and lower tiller density also make tetraploids less durable relative to diploids. Here appropriate grazing management and adequate plant nutrient levels (nitrogen) become important in their performance and persistency.

Also appropriate for summer-moist regions, timothy is used as a supporting grass species for either tall fescue or ryegrass-based deer pastures. Timothy (Phleum pratense) is a strong late-spring and summer performer, offering good quality even during its relatively late-heading phase. New cultivars, Charlton and Viking, both offer improved early-spring yield relative to the old cultivar Kahu, as very small seed rates of 1.0 to 1.5 kg are more than adequate in a mixture.

The appropriate selection of red and white clover cultivars will be subject to regional location and soils. The strong preference by deer for white clover (Trifolium repens) makes cultivar selection important. I believe it also means that the structural characteristics of the various cultivars need to be carefully considered, because the ultimate aim in a deer pasture is to have good white clover stratification from the top of the sward to its base. Fortunately, modern breeding programmes in New Zealand have produced cultivars such as Sustain and Tribute, which are characterised by medium leaf size and medium to high stolon density, with the later important for persistency and recovery from close grazing. There can be further advantages in cool-season yield and availability in high mass swards by using a large leaf cultivar (e.g. Challenge) at ~30-40% of the total white clover sowing rate of 4 kg/ha. New cultivars like Kopu II are achieving significantly higher stolon densities while retaining leaf size, and may obviate the need for mixing medium and large-leaf types in the future.

Red clover (Trifolium pratense) is an important
Companion legumes to have in all deer pastures mixtures. However, as with many tap-rooted species, red clover requires free to moderately-free draining soils, rotational grazing management and shows susceptibility to blanket spraying of most phenox herbicides (e.g., 2,4D, MCPA) often used in thistle and ragwort control. The diploid red clover cultivar Colenso has valuable cool-season yield and as a large seed (2.5x heavier than white clover) should be sown between 3.5-4.5 kg/ha in deer pasture mixtures.

Forage herbs like chicory (Chicorium intybus) and narrow-leaved plantain (Plantago lanceolata) are increasingly being recognised for their beneficial role in deer pastures. We are finding both species are adaptive to a range of soil types and environments, where they offer an important multi-trace element role (Na, Co, Se & Cu). Plantain, for example, has twice the copper and zinc concentrations than ryegrass or white clover (Cu 13 vs 7ppm, and Zn 37 vs 18ppm in ryegrass). However, they can be overdone in sowing rate and as a general guide we will use chicory at 1.25 to 1.75kg/ha (lower rate in the spring) and Tonic plantain at between 0.75 and 1.25kg/ha.

Beyond the established reputation for LWG and impressive seasonal DM yield, recent work by Massey University has confirmed an anthelmintic effect in deer from Lactone compounds in chicory. These compounds retard parasite development within the animal (Hoskins et al., 2002), significantly reducing their egg shed. Massey have also recorded large increases in velvet yield (65% in reds and 100% in hybrids) from stags grazing chicory relative to ryegrass pastures. Along with chicory’s high levels of ME, higher concentration of several key micro-nutrients and macro-nutrients (e.g., calcium and phosphorus, Crush & Evans, 1990) may have direct influence on this.

Often when deer of all age groups encounter forage herbs for the first time they will often ignore them on the first and even second time of exposure. It seems these plant are sufficiently different from other pasture species that the animal has to build up an acceptance profile in its mind before grazing without hesitation. Sometimes this can cause management challenges in pure swards of chicory with weaner deer. However, by routinely including herbs in these general purpose pastures, when grazed by hinds with calves at foot, the transition to acceptance is greatly enhanced.

**Group II: Hybrid ryegrass-based pastures**

Hybrid ryegrass (Lolium hybridium) cultivars combine the best features of annual (Italian) and perennial ryegrasses, with cool-season yield and high digestibility coming from annuals and persistency from their perennial parentage. For this group of pastures, we target the medium and long-term hybrids, giving us between 4-6 years duration of high productivity and performance. There are two key advantages that these hybrid ryegrasses bring to our systems, both steaming from the Italian parentage. The first is their high digestibility and high soluble carbohydrate, low fibre levels relative to perennial ryegrass (i.e., behaving more like tetraploid perennials) and the second is in their cool-season yield. A potential disadvantage can be that they require a faster replacement rate. However, even this can still be an advantage in that it ensures more regular use of superior plant genetics as they become available. There has been significant advancement made by plant breeders in the performance of this group in the last 6-7 years.

Other features include a lack of endophyte, making most of the cultivars potentially susceptible to Argentine stem weevil attack. Therefore, environmental suitability and management will be considerations. One exception to this is the cultivar Galaxy which contains ARI perennial endophyte and is also a tetraploid. For some years we have successfully used Cordura in our programmes, but are now looking at some of the slightly more persistent and productive new cultivars including Maverick Gold, Tabu, Feast II (a tetraploid) and Marbella.

Within deer systems these Group II pastures meet the demanding requirements of finishing weaners exceptionally well. For the critical period from weaning in March to May, hybrid ryegrasses offer the much needed, high energy (MJME) and high pasture covers (mass) for maximising their LWG pre-winter (300-350g/day potential). Cattle provide important complementary grazing behind these animals to ensure quality is maintained.

From mid-August to late-November, hybrid ryegrasses with their early-spring yield, medium to late-heading and reduced aftermarth heading characteristics (cover >2500kg DM/ha and 11.5+ME), ensure early slaughter targets are met and market premiums gained. This performance is ahead of what can be expected from the Group I pastures, which at this time would be better suited to supporting breeding hinds as they enter their third trimester, as well as providing the opportunity for silage (Table 1). The strategic use of hybrid ryegrass pastures in this way provides an excellent lead into the use of the Group III specialist forages like chicory (Table 1).

Clovers and herbs also provide an important role in these pastures, with most of the hybrid ryegrass cultivars showing good complementarity towards inclusion of these species relative to their expected persistency. Where this balance is compromised due to grazing selection pressure.

**TABLE 1: Pasture groups and area % within a self-contained deer system.**

<table>
<thead>
<tr>
<th>Animal</th>
<th>Gestation (early)</th>
<th>Lactation</th>
<th>Weaning &amp; Mating</th>
<th>Gestation (late)</th>
<th>Lactation</th>
<th>Weaning &amp; Mating</th>
<th>Gestation (late)</th>
<th>Lactation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinds</td>
<td>Aug-Oct I</td>
<td>Nov-early-lact. I</td>
<td>Jan-Feb late-lact. III</td>
<td>March pre-rut I</td>
<td>April post-rut I</td>
<td>May-June I and/or IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaners</td>
<td>II</td>
<td>II and/or III</td>
<td>I</td>
<td>II and/or III</td>
<td>II</td>
<td>II and/or IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2 Hinds</td>
<td>I</td>
<td>I and/or III</td>
<td>III</td>
<td>I</td>
<td>I and/or III</td>
<td>I and/or IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
or environment, it is very easy to top these species up by broadcasting more red clover, chicory and plantain back into the pasture. White clover is more difficult to re-establish in this way.

Carefully managed, the application of strategic nitrogen is a critical factor in getting the maximum performance from these Group II pastures. Here the key objective should be to exploit the cool-season growth rate ability of these hybrid ryegrasses. Key times for application in a weaner finishing system are late-February or early-March, early-April and again in early-August, with each dressing between 35-45kg N/ha.

**Group III: Specialist forages (chicory, red clover, lotus corniculatus, lucerne)**

Collectively, this group of energy dense forages which deer show a strong preference for (Figure 1), offer an important strategic nutritional role within a number of deer systems. They offer concentrated yield for 8-9 months of the year, which either equates to or exceeds that of a Group I pasture over 12 months. Many see their winter dormancy as a negative feature. However, when one considers the very high animal performance and carrying capacity that can be achieved during their growing period, and the way in which they fit the feed demand of deer so well, I believe most intensive deer systems shouldn’t be without them in some degree.

Typically their use is associated with growing weaners quickly in the spring to meet early market premiums. But given their peak yield period runs from early-November to through late-February, these forages provide an even greater opportunity for enhancing hind lactation and calf growth rates (Figure 2). It is well recognized that the greatest potential for calf LWG is during the mid and latter part of the lactation alongside the hind (500-700g/hd/day). This impacts positively not only on calf weaning weights, but also hind body condition in preparation for mating. Neizen et al. (1993) showed this with calf growth rates on red clover (+27%) cf. ryegrass/white clover. While Kusmartono et al. (1996b) on chicory pastures recorded 402 g for reds and 490 g/head/day for hybrid calves, 12% and 31% greater respectively, than on ryegrass/white clover pastures. Where a breeding unit only has limited proportions of these Group III pastures, then priority at this time should be given to first calving hinds and low body condition hinds (Table 1).

Specialist pastures like chicory, which start to move in early-September through to early-November, are ideal for bringing weaner stags and hinds up to slaughter weights very quickly (Figure 2). From November through to March they can be switched back again to lactating hinds. In March through to May, forages like chicory can be switched again back to weaner finishing before they become winter dormant (Table 1). Hybrid weaners show a higher proportional LWG response to these forages over straight red deer (chicory vs ryegrass/white clover, reds +38%, hybrid +57%, Kusmartono et al., 1996a: Min et al., 1997).

Animals show high VFI by spending less time in active selection of preferred species when they are sown as monocultures. With sheep this has been measured as high as +26% VFI on clover only compared to ryegrass and clover mixed pasture (Marotti et al., 2002).

In addition, relative to grasses, these species are relatively low in structural carbohydrates and high in soluble carbohydrates, resulting in increasing rumenal flow (speed) which also increases intake and results in increased animal production. For example, chicory was shown to have a ruminating time of only 33 minutes when compared with ryegrass, with half the levels of soluble carbohydrates and twice the levels of structural carbohydrates, having a ruminating time of 260 minutes (Kusmartono et al., 1996a; 1997).

---

**FIGURE 1:** Lactating red hinds pasture species preference during summer (Hunt & Hay 1990).

**FIGURE 2:** Seasonal variations in pasture production and animal requirements in deer production systems in perennial ryegrass/white clovers pastures (Hodgson & Brookes 1999).
Lotus corniculatus (birdsfoot trefoil) has additional advantages over other specialist legumes and herbs species by containing condensed tannins (CT), which improve protein absorption in the animal. In trials this CT effect has been measured in ewes and found to increase ovulation rate by 21% and lambing % by 39% (Min et al. 1999). In the lactating ewe Wang et al. (1996b) reported 21% increased milk production and 14% more protein in the later part of the lactation due to a CT effect.

As a collective summary on grazing management for all four species, it needs to be noted that a key management consideration is to minimize stem development at flowering and maximize leaf production (Clarke et al., 1990a). Typically, this requires relatively strict rotational block grazing management, with a short grazing duration (3-5 days maximum) and relatively generous residual dry matter (RDM 1600-1800kg DM ha) left after grazing. The exception is chicory, where RDM can be as little as 1000kg DM ha without affecting yield (Clarke et al., 1990a, Moloney & Milne 1993). Rotational grazing management is important for two reasons, the first being that it will ensure the best control of stem development. The second is to recognize that, as tap-rooted species are constantly mobilizing stored carbohydrates from their roots, a recovery period must be given following defoliation (grazing), or plants will suffer burnout. Clearly, this grazing management requirement can be at odds with running hinds with calves at foot in the early stages of lactation. As soon as they can be moved in a shuffle or rotational grazing manor, then this requirement can be met.

Of the four species, lucerne offers the most drought tolerance, DM yield and suitability to conservation (silage). However, it should be noted that from a grazing perspective, lucerne tends to have the lowest leaf:stem ratio, making effective utilization a challenge in grazing systems. To minimize this problem where grazing is a priority ahead of conservation, be sure to select a more grazing-orientated cultivar with a higher leaf:stem and greater digestibility.

Lotus and red clover have higher digestibility and are also suited to conservation, which can be a valuable management tool when summer growth accelerates. Chicory can be conserved but this practice, along with mechanical topping, can cause plant mortality by encouraging Sclerotinia spp. infection (ie. cutting of hollow stem which can fill with water). Two successive hard grazings in the mid and late-spring periods is a safer way to keep chicory vegetative (Moloney & Milne 1993). Despite this limitation, chicory offers some of the highest animal production and is in many ways the most durable of the four specialist species in deer systems (Moloney 1990).

Finally, weed control with all four species can be both challenging and expensive, particularly in the pursuit of controlling difficult species such as ragwort and nodding thistle. These generally require phenoxy based herbicides. The only safe way to apply these herbicides is via a rotor wiper device, which takes advantage of selective grazing management and the resulting weed and forage species height differential. Grass control every 2-3 years is likely to be needed, with the cheapest herbicide options tending to be winter applied at peak dormancy.

Renovation rotations and establishment

Group I general purpose pastures have a relatively slow replacement rate of 10% per annum. Typically, either slow maturing single-graze brassica crops (swede, kale), or quick maturing, multiple-graze brassica crops (Pasja (Brassica campestris), Appin turnips) are used as a break between old and new pastures. These crops should more than cover their establishment costs by offering high quality feed but also high stocking rates at key periods, taking pressure off pastures. They also provide an opportunity for weed control, in particular difficult grass weeds species like browntop, as pre-emergence herbicides like Trifluralin (e.g. Treflan) can be used as a broad spectrum grass and broadleaf herbicide.

Group II hybrid ryegrass pastures are on a faster replacement rate of 20-25% per annum, and will often be autumn-sown grass-to-grass rotation using a single spray and direct-drill establishment. However, where contaminant weed grasses (e.g. Yorkshire fog, browntop) become too numerous, a short-term brassica can be used (e.g. spring sown Pasja, or early-autumn sown Appin turnips).

Group III specialist forages. Chicory is typically on a 20% per annum replacement rate, with interim top-ups possible through broadcasting in year 3 or 4 depending on plant densities. Brassica crops should be avoided as a precursor to chicory stands as these can encourage the build up of the fungal disease Sclerotinia sclerotiorum, which can cause tap root failure. This leaves short-term annual ryegrasses or cereals as crop options, with sowing in either spring or autumn for most regions. To minimize the build up of this soil-borne pathogen, paddocks with 8-10 years continuous chicory production should ideally be fallowed back into Group I or II pastures. Watch the sowing depth of chicory, as it should not be sown deeper than 2cm, with the optimum depth 1-1.5cm (Moloney & Milne 1993).

Lotus corniculatus is typically spring sown and can follow any grass-to-crop to lotus rotations, including brassicas. Along with chicory, it can also be sown in a grass-to-grass rotation providing it is a cultivated seedbed following careful mouldboard ploughing and the soil incorporation of Trifluralin. Like lucerne, lotus has a slower replacement rate of 10-15% per annum, or a stand life of 7-10 years.

Proportions of pasture Groups in deer systems

This is an area one cannot afford to be too prescriptive about due to the many variables (system type and objectives, climate, soils and topography) that will influence this decision. However, in broad terms, if one assumes a property had an integrated deer system (ie. breeding and finishing), with a good proportion of both wheel tractor accessible country, which included some flat to easy hill with good to medium drainage, then Table 1 provides some target ranges for consideration. It also shows a deployment sequence for the 12 months of production, showing when the various groups of pasture
are most likely to be appropriate for the different classes of animals. The reference to Group IV forages is to cover various types of forage crop options that could be used in a renewal programme.

Typically Group I pastures (Table 1) should make up 45-50%, followed by Group II hybrid ryegrasses at 25%. For Group III pastures it is essential to have blocks of these pastures which are carefully planned from a logistics perspective (e.g. weaners interchanging with hinds and then back again). I believe it is also important to build to critical mass (area) of these species as quickly as possible. Both strategies will combine to make grazing management easier and ensure the benefits of these pastures impact quicker on the enterprises profitability.

In Manawatu farmlet trials (D. Clarke & W Thomas unpub. 1991) 20% of the total area was sown in chicory (Group III) and the balance in Group I pastures. Against the control (100% Group I) they recorded 26% increase in weaner weights and carried 17% higher stocking rate (11.7 hinds/ha).

REFERENCES


Kusmartono, S.A.; Barry, T.N.; Wilson, P.R.; Kemp, P.D.; Stafford, K.J. 1996a: Effects of grazing chicory (Cichorium intybus) and perennial ryegrass (Lolium perenne)/white clover (Trifolium repens) pasture upon growth and voluntary feed intake of red and hybrid deer during lactation and post weaning growth. Journal of agricultural science, Cambridge 127: 387-401.


Min, B.R.; Barry, T.N.; Wilson, P.R.; Kemp, P.D. 1997: The effects of grazing chicory (Cichorium intybus) and birdsfoot trefoil (Lotus corniculatus) on venison and velvet production by weaner red and hybrid deer. New Zealand journal of agricultural research. 40: 325-347.