Pasture use and management in commercial equine production systems

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Abstract

Despite a perceived reliance of horses on pasture there are limited data on efficiency of pasture utilisation in equine production systems. The unique equine behaviour characteristics of highly selective browsing, combined with faecal avoidance, provide distinct grazing management challenges compared to those of ruminants. Data reported here show that faecal avoidance results in the establishment of lawns and roughs (overgrazed and poorly grazed areas, respectively) with it estimated that only 70% of the total pasture DM/ha on offer is utilised by horses. During spring, lawns contained more grass (74% vs 53%) and clover (5% vs 3%) and less weeds (2% vs. 11%) and dead matter (19% vs. 33%) than did roughs. Weanlings will start to graze roughs once the lawns are <1500 kg DM/ha. Roughs, however, will not be grazed within 1 m of a faecal pile. This translates to a lower pasture utilisation rate in weanlings and the biased grazing pattern means estimates of total pasture DM over-estimate the true available pasture DM. The relative proportion of pasture in lawns and roughs changes during grazing and prevents the application of a simple correction factor to estimate available DM. Broodmares had greater rates of pasture utilisation and less bias for consumption of pasture in areas of roughs than did weanlings.

Keywords: horse; pasture; thoroughbred; nutrition; studfarm

Introduction

Commercial horse breeders in New Zealand have the opportunity to grow and rear young stock using a pasture-based production system. The ability to graze horses at pasture year round is unique internationally and offers the New Zealand breeder a number of advantages over international competitors, particularly in relation to the musculoskeletal development of the foal (Rogers et al. 2012). The positive effect of rearing horses outdoors on pasture has been a focal point of the marketing of New Zealand Thoroughbreds for a number of years (Waldron et al. 2011; Fennessy 2010).

Despite the recognition of the advantages of growing horses at pasture and the reliance on pasture as a primary source of nutrition for commercial horse production in New Zealand, there is limited literature on the efficiency of utilisation of pasture by horses and effective management of pasture on commercial equine properties. Early literature identified the effect that selective grazing and avoidance of latrine areas had on pasture utilisation, with the figure of 50% utilisation of DM on offer proposed for all classes of equine livestock (Goold et al. 1988). This low figure is in contrast to the 80% proposed for cattle on the same property. In addition, there is difficulty in estimating true utilisation of total pasture offered if areas of lawns and roughs (overgrazed and poorly grazed areas, respectively) are not considered separately.

The development of roughs (patches of long, rank grass) appears to be driven by faecal avoidance due to residual smell in the soil (Hunt 1994). Thus, sequential grazing of the pasture by horses will establish these areas quickly and lead to disparity in not just pasture DM availability, but also pasture quality and species abundance (Hunt 1994).

Trials evaluating both time spent grazing and pre- and post-grazing pasture mass have identified that pasture preference in horses appears to be related to higher non-structural carbohydrate and lower fibre content (Randall et al. 2014; Hunt & Hay 1990). Perennial Ryegrasses (*Lolium perenne*), particularly the tetraploid varieties, were the most preferred in the trials reported by Randall et al. (2014) and highly ranked in preference in the work reported by Hunt & Hay (1990). The persistence of Perennial Ryegrass and its high ranking in pasture-preference trials may explain, in part, the reported dominance of this species on most commercial stud farms (Rogers et al. 2007).

Despite the widespread recognition of the advantages of raising horses at pasture many commercial Thoroughbred breeders will provide concentrates that meet up to 30-50% of the weanlings estimated digestible energy (DE) requirement (Rogers et al. 2007; Stowers et al. 2009). This reliance on concentrates may be due to difficulties in both estimating pasture intake, and maximising pasture quality and quantity under sustained grazing by horses.

It is estimated that 10-15% of the foal crop may not be presented for sale as yearlings due to a collection of orthopaedic conditions described as development orthopaedic disease (DOD) (Morley & Townsend 1997). Within this group of conditions, which are multifactorial in nature, it has been recognised that the feeding of large quantities of concentrate feed (grain-based supplements) increases the risk of DOD (Lepeule et al. 2013). The availability of good quality pasture with high digestibility provides a cost-effective and pragmatic alternative for the New Zealand breeder to optimise growth without the increased health risks associated with feeding large quantities of concentrates (Grace et al. 2003; Brown-Douglas et al. 2005). However, optimising pasture quantity

and quality to maximise animal growth requires greater understanding of the pattern of pasture utilisation by the different classes of equine livestock managed under commercial conditions.

The objectives of this paper are to describe the utilisation of pasture by horses under commercial management systems and to identify difficulties in accurately estimating pasture utilisation by horses, using data collected from three separate studies.

Materials and methods

Study 1: Cross sectional survey of pasture composition on commercial equine stud farms

A full description of the cross-sectional survey methods were reported by Hirst (2011). In brief, botanical composition and nutrient composition of pasture samples (3 representative paddocks per farm) were collected across one breeding season (2009-2010) from 26 commercial equine stud farms (four Standardbred and 22 Thoroughbred) distributed across New Zealand. Samples were collected on four occasions (spring, summer, autumn, winter). Seasonal pasture botanical composition was estimated for each of the three paddocks on each farm using a representative sample (~1 kg wet weight) and sorted into the categories of grasses, clover, dead matter and weeds. Pasture samples were weighed fresh (wet weight) and stored frozen (-20° C) until drying at 75˚C for 24 hours and weighed again to estimate percentage DM. Metabolisable energy values were estimated using a subsample (100 g) of the pasture samples using Near–Infrared-Spectroscopy (NIRS) analysis (Feedtech laboratory, AgResearch, Palmerston North, New Zealand). Difference among seasons were tested using an ANOVA within Stata version 12 (StataCorp LP, College Station, TX, USA).

Study 2: Pasture utilisation by Thoroughbred weanlings

For 15 weeks between March and July 2016 measurements of pasture DM were obtained at weekly intervals for paddocks occupied by two cohorts of weanlings (n=6 in each cohort) on a commercial Thoroughbred studfarm in the Manawatu region of New Zealand. Measurements for the total pasture DM, lawn pasture DM (patches of pasture with a sward height of < 4cm) and rough pasture (patches of pasture with a sward height of ≥ 4cm) were estimated using a rising plate meter. Botanical composition was estimated for the entire paddock and lawns and roughs from six samples per paddock, once in May and again in July. Pasture was sorted into the categories of grasses, clover, dead matter and weeds. Pasture growth rate was estimated from three pasture cuts of 0.18 m^2 quadrants within each paddock. Pasture samples were weighed fresh (wet weight), then dried at 75˚C for 24 hours and weighed again (to estimate percentage DM).

Study 3: Set stocked Thoroughbred and Standardbred mares

Twenty-four mixed-age and breed (Thoroughbred and Standardbred) mares were randomly allocated to three groups (n=8) and set stocked in three paddocks of similar size (~2 ha) from November 2001 to May 2002. In Paddock 1, all faeces were removed on a daily basis, in Paddock 2 no faeces were disturbed, and Paddock 3 was harrowed once every two weeks. Pasture samples were taken from all paddocks once every two weeks and multiple sward height measurements (approximately 15-17) were taken from all paddocks monthly. Lawns were classified as a having sward height of <4 cm and roughs as having a sward height >4 cm.

Results

Study 1: Pasture composition and seasonal changes

Pasture composition data collected across a single season from 26 commercial thoroughbred stud farms are presented in Table 1. Under commercial management conditions there was a large increase in pasture dead matter and reduction in ryegrass percentage during summer.

Study 2: Pasture utilisation by Thoroughbred weanlings

Based on an estimated body weight of 235 kg at the start of the trial it was estimated that the weanlings required 77.6 MJ DE / day for maintenance and growth (NRC

Table 1 Seasonal botanical composition of equine pastures (values % of total sample DM) and metabolisable energy estimates (MJ) (mean ± SEM) collected from commercial equine stud farms in New Zealand (n=26) during the 2009 to 2010 season

	Spring	Summer	Autumn	Winter
Ryegrass	70±2%^{a}	42±2%^{b}	63±2%^{c}	80±2%^{d}
Other grass species	12±2%^{a}	19±2%^{b}	16±2%^{b}	10±2%^{c}
Total clover	8±1%^{a}	13±2%^{a}	10±1%^{a}	3±0.5%^{b}
Weeds	10±1%^{a}	6±1%^{b}	6±1%b	3±0.5%^{c}
Dead matter	1±0.5%^{a}	20±2%^{b}	4±1%^{c}	4±1%^{c}
Metabolisable energy (MJ)	12.6±0.1^a	9.3±0.1^b	10.7±0.1^c	11.2±0.1^d

Footnote: different superscript within a row are significantly different P<0.05

Figure 1 Changes in estimated total pasture kg DM/ha and estimated pasture kg DM/ha for the areas identified as lawns (sward height <4cm) and roughs (sward height >4cm) for a paddock grazed by six Thoroughbred weanlings set stocked during a 15-week observation

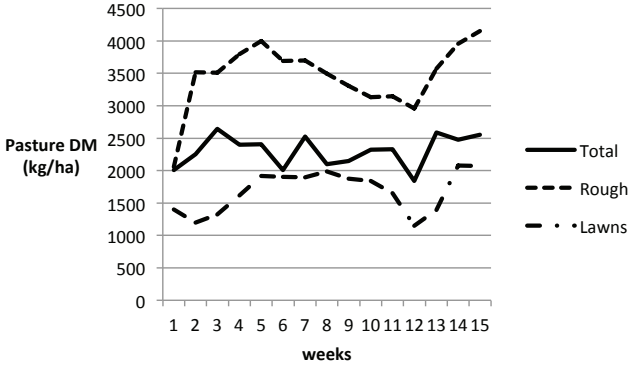
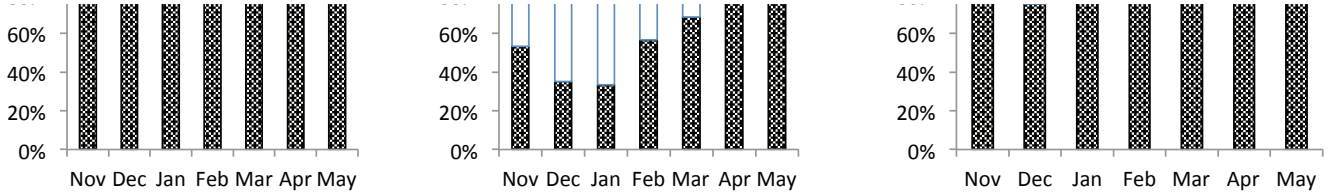


Figure 2 The percentage of quadrat pasture sample identified as either lawns (sward height <4cm, hashed) or roughs (clear) with set stocked mares under three different management conditions from November to May.



Paddock 1 (faeces removed daily) Paddock 2 (no faeces removed) Paddock 3 (harrowed every 2 weeks)

2007). During the 15-week study period, the weanlings were offered 2 kg of a commercial concentrate supplement feed (Wenham Mix, 10.5 MJ DE/kg DM) once a day in individual feed bins while at pasture. Supplementary feed would, therefore, provide 17.9 MJ DE/day/weanling with the remaining 59.7 MJ DE/day/weanling being provided by pasture. Pasture cuts provided an estimated pasture growth rate of 44.0 kg DM/ha/day. Thus with a stocking rate of 2.4 weanlings/ha and a predicted pasture intake of 5.97 kg DM (assuming a pasture DE content of 10 MJ DE/kg DM) results indicate that the weanlings pasture demand was less than the daily pasture growth resulting in a positive daily residual of approximately 29.7 kg DM/ha. Estimates of total pasture DM and the DM for lawns and roughs are presented in Figure 1. Pasture DM/ha in the lawns remained below 2000 kg DM/ha and after week four it appeared that the weanlings started to graze the peripheral areas of the roughs resulting in a reduced pasture DM/ha of the roughs.

Study 3: Set-stocked Thoroughbred and Standardbred mares

Due to the high value per individual animal and the flight instinct of the horse, many pasture-based farms manage horses on a semi-set stocked or long-rotation-length management system. Under experimental set-stocking conditions the removal of faeces daily, or harrowing once every two weeks (Paddocks 1 and 3, respectively) prevented the development of lawns and roughs. In pasture where faeces were undisturbed (Paddock 2) roughs were first observed in November (after 1 month of grazing). The percentage of lawns and roughs observed with the different management conditions are presented in Figure 2. In Paddock 2 (undisturbed faeces) the percentage of roughs continued to increase until the reduction in total pasture DM resulted in increased grazing pressure into the areas previously identified as roughs.

Discussion

The preferential grazing of horses and avoidance of areas used for defecation and urination provides a number of challenges for the commercial production of horses at pasture. Many farms have historically managed this with the use of extensive cross grazing with cattle and to a lesser extent, sheep, to maintain pasture quality and quantity. This preferential grazing pattern and resulting lawns and roughs makes estimation of true pasture DM on offer for horses difficult to estimate. This difficulty and the industry bias towards using concentrate feed may explain why there is limited data within the literature providing guides on how to best interpret true pasture DM on offer for horses at pasture.

The data presented here for different classes of equine livestock indicate that there may be an age-related change in reluctance to graze roughs. In general, on commercial farms, broodmares are provided with limited concentrates and rely on pasture as the primary source of nutrition (except for the provision of small quantities of mineral balancer in their third trimester of pregnancy). It is, therefore, difficult to determine if some of the differences are due to age or due to reliance on pasture as the primary or sole source of nutrition.

Commercial Thoroughbred weanlings are typically provided with significant quantities of concentrates, despite the feeding of large quantities of concentrates being implicated in increasing the risk of some developmental orthopaedic diseases (DOD) such as osteochondrosis (OCD) (Lepeule et al. 2009; 2013). Pasture within New Zealand, due to its relatively high digestibility and ME, provides a cost-effective alternative to optimise growth of young horses while reducing the risk of DOD (Grace et al. 2002; 2003). Under modelled commercial conditions, equivalent growth rates for Thoroughbreds have been achieved from a pasture-only diet (Brown-Douglas et al. 2005). The data from Study 2 demonstrated that when pasture DM in the lawns dropped to ≤1500 kg DM/ha, the weanlings started to consume some of the area previously identified as roughs. This transition from consumption of preferred to least-preferred areas may be associated with a reduced voluntary feed intake and/or the consumption of lower-quality pasture which may reduce the potential to maximise growth from pasture. A similar trend has been reported in dairy bull calves with reduced voluntary feed intake when pasture DM fell below 1600 kg DM/ha (Pettigrew et al. 2017). The consumption of roughs may also be associated with the risk of increased rate of ingestion of infective larvae as horses graze closer to faecal piles (Fleurance et al. 2007). Grazing within 1 m of faecal piles was associated with greater risk of parasite reinfection, thus, the 1 m radius of a faecal pile provides a simple management tool to minimise the risk of ingestion of infective larvae

To maximise pasture utilisation and reduce ingestion of infective larvae, a simple working formula to use with youngstock (weanlings and yearlings) could be to change paddocks once the pasture DM of the lawns falls below 1500 kg DM/ha and/or horses are grazing within 1 m of a faecal pile (within roughs). Monitoring and feed-budget data on commercial Thoroughbred farms indicates that pasture utilisation for horses is approximately 70% of the DM on offer (Rogers et al. 2017). Cross grazing with cattle provides the opportunity to utilise much of the remaining 30% pasture DM with no detrimental effect on equine pasture intake. A secondary advantage of such a system is the prevention of selective overgrazing (the development of lawns and roughs), maintaining pasture quality, and potentially reducing equine-associated animal-health costs. The equine industry is facing an emergence of drench resistance to the most widely used and available anthelminthic drenches (Rosanowski et al. 2017). Thus, the ability to reduce drench use and decrease the opportunity for ingestion of infective larvae is an emerging issue of importance for the equine industry.

Under commercial management systems, pasture utilisation by broodmares appears greater than that of the young stock due to a lower threshold for the transition to graze into the roughs, and thus, pasture management for broodmares likely requires a different set of guidelines. There may also be some between breed differences in pasture utilisation which require further examination. Thoroughbred broodmares were reported to be managed in cohorts of six to 12 mares and were allocated an estimated pre-grazing mass of ~3500 kg DM/ ha and typical post-grazing pasture masses of 1500-1750 kg DM/ ha (Rogers et al. 2007). In contrast, Standardbred farms will typically run broodmares in larger groups with an estimated post-grazing mass of as little as 1000 kg DM/ ha (R Stone *Unpublished data* 2016). These differences in the pasture on offer and the management system may reflect breed and production-system differences between the Standardbred and Thoroughbred, namely the perceived greater feed conversion efficiency of the Standardbred, the lower production costs and sales returns, and the geographic concentration of the Standardbred industry in the Canterbury and Southland regions

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