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Sheep and deer grazing of pasture close to cattle dung pats

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ABSTRACT

An experiment compared the grazing of deer and sheep on pasture with or without contamination by cattle dung pats. Sheep (35 ewes) and deer (24 hinds) separately grazed 0.4 ha plots of a ryegrass/white clover pasture. Half of the area (4 subplots) was contaminated with artificially applied cattle dung pats (DP), 30 cm in diameter, using fresh cattle dung at an application rate of 1 dung pat per 4 m^2. The remaining four subplots were left uncontaminated (NDP). Mean pasture mass was estimated daily (rising plate meter) on DP and NDP plots. In addition, pasture height (sward stick) was recorded daily at 10 cm intervals from 0 to 100 cm from pre-marked dung pats and from pegged point sources in NDP plots. The experiment lasted 10-11 days and mean pasture mass declined from 2850 to 1500 kg DM/ha. Grazing pressure was controlled by altering numbers of livestock to maintain < 250 kg DM/ha difference between each species plot.

There was no difference in the mean pasture mass of the sheep or deer grazed plots at any stage of the experiment. However both species grazed pasture near pegs (NDP plots) to a lower mean height ($P<0.001$) than near dung pats although the difference was greater for deer (7.4 and 9.0 cm near pegs and near dung pats respectively) than sheep (8.0 and 8.3 cm near pegs and dung pats respectively). Sward height of pasture at 10-20 cm from dung pats grazed by deer was higher than sheep grazed pasture for days 1, and 3-7 of the trial ($P<0.001$).

The results from this experiment indicate that although deer graze pasture around cattle dung pats, they show more of a preference for grazing further away from dung pats than do sheep. This finding should help to establish the potential for deer to substitute for sheep under mixed grazing situations involving cattle.

Keywords: cattle; complementarity; dung pats; deer; mixed grazing; sheep.

INTRODUCTION

Numerous authors have found species interact in co-foraging situations throughout nature (Bell, 1971; McNaughton, 1976; Van der wal *et al.*, 2000) and many authors have studied or commented on the potential benefit of co-grazing ungulate species (particularly sheep, cattle and goats) to animal production (Forbes and Hodgson, 1985; Hodgson *et al.*, 1985; Kitessa, 1997; Kitessa and Nicol, 1996; Lambert and Guerin, 1989; Nicol, 1997; Nolan and Connolly, 1977; Wright and Connolly, 1995). Under mixed grazing livestock situations, possibilities exist for competition or complementarity between the grazing species which can modify overall farm productivity and efficiency.

A complementarity of sheep and cattle co-grazing is the utilisation by sheep of herbage within the vicinity of cattle dung pats. Several studies have found that sheep are more inclined to graze within the surrounding area of cattle dung pats (De Rancourt *et al.*, 1980; Forbes and Hodgson, 1985; Ronnel *et al.*, 1980) than cattle. It was suggested by Nolan and Connolly (1989) that this is perhaps the most widely recognised example of how complementary grazing can increase pasture utilisation and thus increase total animal output per hectare. These authors found that sheep acceptance for those areas left un-grazed by cattle gave rise to improved pasture utilisation and increased total animal performance.

Deer and cattle are increasingly being grazed together on the same areas of land. The number of deer being run on primarily beef farms has risen markedly in the last decade (New Zealand Department of Statistics, 1995, 2003). Many deer farms already incorporate cattle as a proportion of the total stock units (Moloney, 2003). Consequently it is important to understand the potential for complementarity or competition between these two species when being run together; especially if the deer industry contracts and cattle substitute for a proportion of deer on deer fenced areas. This study considers the effectiveness of deer compared to sheep in grazing around cattle dung pats.

METHOD AND MATERIALS

Experimental design

The experiment consisted of treatments in which a single group of deer or sheep grazed separately on 0.4 ha plots. Each plot was marked out into eight sub-plots of 0.05 ha. Four of the eight sub-plots were contaminated with cattle dung pats (DP). DP plots were 'seeded' with artificially applied dung pats using 'cake tins' which were 30 cm in diameter at a rate of 1 every 4 m^2, so that 1.75% of the area was covered with dung. Approximately 800 kg of fresh cattle dung was sourced from the Lincoln University dairy farm from the entry/exit lanes to and from the dairy shed and collected and applied at 2 daily intervals for 6 days prior to the experimental grazing. The remaining four sub-plots in both sheep and deer plots were left uncontaminated (NDP). Animals were put onto plots on the 28 May. All plots had been previously grazed by deer only. An electrical wire netting fence was used to contain sheep in their respective plot while the deer plot was fenced with standard deer fence netting. Water was available to both groups.

Pasture and pasture measurements

The trial was conducted on the Lincoln University Research Farm in May-June 2005. The soil is a Templeton silt loam of moderate fertility (Olsen P = 18) and the area receives a mean annual rainfall of 650 mm. The area used for this trial had been sown with a perennial ryegrass (*Lollium perenne*) (Grasslands Nui cultivar) and white clover (*Trifolium repens*) (Grasslands Huia cultivar) in 1992. Pasture mass of all plots was estimated indirectly through a use of a rising plate meter (Filips folding plate pasture meter, Jenquip, Hamilton, NZ) on a daily basis by taking 25 measurements per sub-plot. Within each 0.05 ha DP sub-plot; two dung pats were selected randomly and sward surface height (SSH) recorded by a HRFO sward stick (Barthram, 1986) on a daily basis at 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 cm distant from the edges of both north and south sides. SSH was also recorded at the same distances from two pegs within each corresponding NDP sub-plot.

The relative rate of pasture mass decline was used as the determining factor to control grazing pressure between the two main treatments. Animals were removed to ensure a similar rate of pasture removal (within 250 kg DM/ha between sheep and deer). The experiment was terminated and all animals removed from their respective plots when pasture mass values reached 1500 kg DM/ha.

Pasture samples (0.2m^2) were cut from representative areas of DP and NDP plots on days 0, 5 and 11 of the trial. These samples were chilled and freeze dried, ground in a centrifugal mill to pass through a 1 mm screen and dry matter (DM), crude protein content and DM digestability estimated using near infrared reflectance spectrometry (NIRS) (Foss NIRSystems 5000) by the Analytical Service Unit, Agriculture and Life Science Division, Lincoln University.

Animals

The number of deer and sheep required for the experiment was established on a metabolic liveweight$^{0.75}$ of approximately 780 kg/plot. Thus 35 Coopworth ewes (mean liveweight (LW) of 63 kg) (mixed age) and 24 red deer hinds (mean LW of 98 kg) (mixed age) were selected from larger populations to minimise variation in animal LW. The experiment was approved by the Lincoln University Animal Ethics Committee (Application No. 70).

Statistical analysis

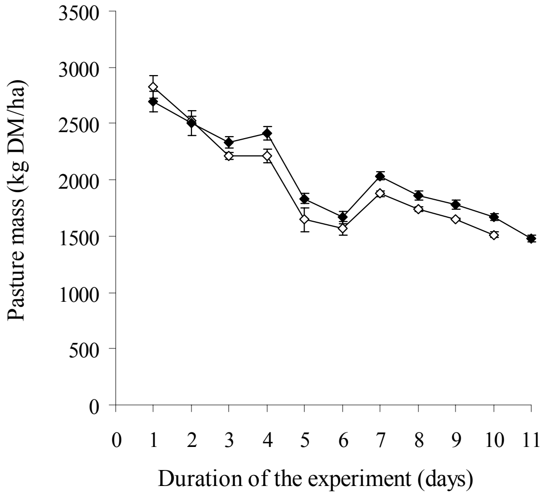
All statistical analyses were performed using a residual maximum likelihood (REML) routine (GENSTAT, Lawes Agricultural Trust, 2003). The model included terms for the treatments (species, distance, date, and dung pat/non-dung pat area) as fixed effects and the variable effect of SSH within 100 cm of dung pats/pegs.

The model also included a term to describe the structure of the related measurements (autoregressive). The REML option was used to estimate mean values, approximate standard errors of the differences (SED) and standard errors of the means (SEM) for parameters. The significance of individual estimated mean values was determined by performing two sample *t*-tests with appropriate degrees of freedom and SED.

RESULTS

The change in pasture mass (kg DM/ha) throughout the duration of the trial is shown in Figure 1 for deer and sheep grazed plots. At no time throughout the experiment did the difference in mean pasture mass between the two species exceed the predetermined 250 kg DM/ha threshold. Deer were removed from their plot on day 10 and sheep on day 11 as they had reached the predetermined pasture mass limit (1500 kg DM/ha).

FIGURE 1: Apparent decline in pasture mass (kg DM/ha) measured with a rising plate meter of plots grazed by deer (◊) or sheep (♦) for the duration of the trial.



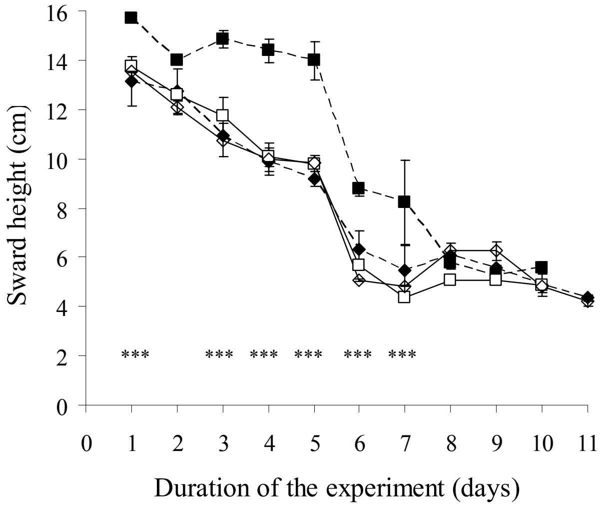
There was no significant (P<0.05) difference in the mean pasture mass on DP and NDP sub-plots grazed by either deer or sheep (Table 1). Similarly there was no significant (P<0.05) species effect on the mean SSH close to dung pats or pegs. However, under both species, the mean SSH close to dung pats was significantly higher (P<0.001) than that close to pegs although the difference was much greater (9.0±0.37 vs 7.4±0.29 cm for near dung pats and pegs respectively) under deer grazing than under sheep grazing (8.3±0.26 and 8.0±0.30 for near dung pats and pegs respectively).

TABLE 1: Mean pasture mass of dung pat (DP) and non-dung pat (NDP) plots and overall mean sward height near dung pats and near pegs for areas grazed by deer or sheep. Sward height values shown are the mean of 11 recordings taken at 10 cm increments from the dung pat/peg during a 10-11 day period. Letters represent significant differences between areas and species.

Species	Pasture mass (kg DM/ha)		
	DP plots	NDP plots	SED
Deer	1804a	1804a	102
Sheep	1918a	1875a	
SED	102		
	Sward height (cm)		
	Near dung pats	Near pegs	SED
Deer	9.0a	7.4b	0.565
Sheep	8.3a	8.0b	
SED	0.082		

Mean SSH within 20 cm of dung pats was significantly higher under deer grazing in comparison with sheep for days 1, and 3-7 of the trial (Figure 2). In contrast, the mean heights of pasture grazed by sheep at 10-20, 80-90 cm and deer at 80-90 cm distant from dung pats were very similar and non significant throughout the duration of the trial.

FIGURE 2: Mean sward surface height (± SEM) near dung pats grazed by deer at 10-20 cm distant (dashed; ■), 80-90 cm distant (solid; □) and sheep 10-20 cm distant (dashed; ♦), 80-90 cm distant (solid; ◊). Stars indicate differences (P<0.001) between deer and sheep grazed sward height at 10-20 cm distant from dung pats.



The composition (dry matter, dry matter digestibility and crude protein concentration) of the pasture available to the deer and sheep on days 0, 5 and 11 is shown in Table 2. The digestibility of the pasture on offer declined under grazing by both species but there was no marked difference between species in any of the variables measured.

TABLE 2: The dry matter, digestibility and crude protein concentration of pasture available to deer and sheep on days 0, 5 and 11 of an 11 day experiment. (Single samples representative of both DP and NDP areas).

Component	Day 0		Day 5	Day 11
Dry matter (g/kg fresh)	165	Deer	168	161
		Sheep	140	152
Digestibility (g DDM/kg DM)	813	Deer	772	665
		Sheep	725	664
Crude protein (g CP/kg DM)	137	Deer	137	108
		Sheep	165	101

DISCUSSION

The results of this study partially support the hypothesis that deer graze as close to dung pats as sheep. Both species grazed pasture contaminated by artificially applied cattle dung pats. This finding that deer graze pasture near cattle dung pats has not previously been formally reported and puts deer in a similar category to sheep, as many authors have shown sheep graze pasture near cattle dung pats. De Rancourt *et al.* (1980) commented that sheep seem to prefer grazing tall grass areas (affected by cattle dung pats) approximately twice as much as cattle. Forbes and Hodgson (1985) found that both cattle and sheep spent progressively more time grazing on areas previously grazed by the opposite species as swards are grazed progressively lower.

Previous studies have also found that the grazing strategy of sheep tends to reduce the proportion of infrequently grazed pasture when grazing together with cattle (Kitessa and Nicol, 1996; Nolan and Connolly, 1992) in comparison with cattle grazing alone. The results obtained from this experiment suggest a similar observation might be made for deer.

The observation that the mean pasture mass was not significantly different between grazing species or between DP and NDP plots (Table 1) suggests that deer and sheep were equally effective in grazing around cattle dung pats and that neither showed any preference for DP or NDP areas. However, the SSH close to dung pats was significantly higher than that close to pegs for both species showing some rejection of pasture close to dung pats (Table 1). Because only 1.75% of the DP area was covered with faeces, this higher sward *height* close to dung pats was not reflected in higher average pasture *mass* over the whole DP plot.

Although the interaction of grazing species and mean SSH close to dung pats and pegs was not significant (Table 1), the difference between the two sites was much greater for deer (22%) than for sheep (4%) and an important trend has been disguised. When SSH close to and distant from dung pats were compared (Figure 2), the SSH close to dung pats grazed by deer was significantly higher than that under sheep until day 7.

There is no obvious explanation for why deer apparently avoided grazing close to dung pats more so than sheep. The response of animals to faeces of their own species is known to be a function of their parasite status and the age of the dung pat (Cooper *et al.*, 2000; Hutchings *et al.*, 2001). It is possible that deer react differently from sheep to cattle faeces even though there appears to be less commonality of internal parasite species between deer and cattle than sheep and cattle (Pomeroy, 1997), however this hypothesis needs to be tested. As dung pats age, animals are less aversive to grazing around them (Hutchings *et al.*, 2001) and more pasture is rejected at a high pasture availability than when less is available (Forbes and Hodgson, 1985), Therefore it is difficult to argue whether the greater acceptance of grazing close to dung pats by deer from day 7-11 represented an effect of dung pat age and/or pasture availability. In the case of sheep it would appear that they only responded to the effect of pasture mass as SSH close to dung pats was similar to that near pegs every day.

Another possible explanation for the greater avoidance of deer for pasture close to dung pats is that these deer had not experienced cattle dung pats previously whereas the sheep may have had previous exposure. Novel feed sources, (in this case, pasture close to cattle dung pats) are often not readily accepted (Provenza, 1996).

This experiment could be criticised for not including a cattle treatment to confirm that sheep and deer graze closer to cattle dung pats than cattle. This was initially contemplated but rejected on the grounds that over a period of 10 days, cattle would confound their treatment by increasing the proportion of the area contaminated with faeces. Such an experiment would have to be done over short periods of time and involve different techniques such as ‘marking’ the pasture around dung pats and measuring the marker concentration in representative faecal samples.

Whether deer can be considered as effective as, or substitute for sheep for grazing pasture close to cattle dung pats will depend on the intensity of grazing adopted. For example, if the post-grazing mass (PGPM) of pasture contaminated with cattle faeces was to be above 2000 kg DM/ha, then there would be considerably more patchiness if subsequently grazed by deer than sheep. However if a mean PGPM of 1500 kg DM/ha was adopted, the level of patchiness would be negligible with either deer or sheep grazing. Therefore the choice of the class of deer for grazing pasture after cattle is an important consideration. It may be preferable for farmers to use stock such as non-pregnant hinds which can be grazed to a lower PGPM than young growing deer or lactating hinds which require higher PGPM.

We conclude that deer are almost as effective as sheep in grazing pasture close to cattle dung pats and thus potential exists for complementarity between deer and cattle.

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