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Grazing behaviour of sheep and ryegrass staggers

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ABSTRACT

Defoliation patterns of sheep grazing a staggers-prone, ryegrass-dominant pasture were studied at Palmerston North during the 1982-83 summer—autumn period. The 0.4 ha pasture was grazed for 5 to 8 days each month from November to May by groups of 30 to 50 sheep.

Herbage at dung patch sites present in January covered about 25% of the pasture area and remained ungrazed until May. Urine-patch sites covered about 35% (16 to 45%) of the pasture area and although urine-patch herbage was grazed before other types, differences were detected within this category: the most recent urine-patches were defoliated sooner and to a greater extent than older ones. Ryegrass at interexcreta sites was defoliated less frequently and to a lesser extent than that at urine-patch sites, except for those interexcreta sites that also contained white clover.

Concentrations of the ryegrass endophyte, *Acremonium loliae*, were higher in live ryegrass sheath at urine-patch than at inter-excreta sites. The results are discussed in relation to the acquisition of neurotoxins by sheep.

Keywords Grazing behaviour; defoliation patterns; sheep; ryegrass staggers; ryegrass endophyte

INTRODUCTION

One of the characteristic features of grazed-pasture ecosystems is the heterogeneity that exists from micro-site to micro-site as a result of plant, animal, soil and environmental factors and interactions (Harris, 1970; Keogh, 1973 a;b). A major source of variation results from the deposition of livestock dung and urine. These very different excremental products have contrasting influences not only on the growth of pasture plants but also on the feeding responses of the livestock themselves (Keogh, 1973 a; 1975; Marsh and Campling, 1970).

Earlier studies on perennial ryegrass-dominant, staggers-prone pastures during summer—autumn periods showed that growth rates and tiller densities of ryegrass were much higher at urine-patch than other types of site; that development of certain fungal saprophytes was much greater at urine-patch sites than elsewhere (Keogh, 1973 b; 1975); that sheep grazed herbage at urine-patch sites in preference to that at other sites (Keogh, 1973 a; 1975; 1978); and that the causal factor(s) (neurotoxins) involved in the development of the neuromuscular condition known as ryegrass staggers (RGS) were ingested from the basal zone of these pastures (Keogh 1973 c; 1978). Although the development of RGS was greater on nitrogen fertilised ryegrass pastures it was not established that neurotoxicity levels were higher at urine-patch sites than other sites in staggers-prone pastures.

More recent studies have implicated a fungal endophyte of ryegrass, *Acremonium loliae* (G. C. M. Latch, pers. comm.) as the causal organism of RGS (Fletcher and Harvey, 1981) and tremorgenic compounds designated as lolitrems (Gallagher *et al.*, 1981) as the most likely neurotoxic agents. However, apart from evidence showing that both *A. loliae* (Musgrave and Fletcher, 1984) and lolitrem B (Gallagher *et al.*, 1982) levels are higher in stubble than leaf of ryegrass plants, there is no information on site to site variation within grazed pastures.

This paper contains information on the *A. loliae* endophyte levels and distribution, and on the defoliation patterns of sheep within defined site classes in a rotationally-grazed staggers-prone pasture.

METHODS

A 0.4 ha staggers-prone pasture was rotationally grazed by groups of 30 to 50 sheep for 5 to 8 days each month from November 1982 to May 1983. The sheep were checked for signs of RGS at the start and finish of each grazing period.

The following types of site were located and marked after the November grazing: urine-patch (UP), dung-patch (DP), interexcreta (IE), and interexcreta containing white clover (IEWC). Further fresh UP sites were located and marked following the January, February and March grazings and designated as UP2, UP3, UP4. The ages of the different series of UP at the start of grazing periods 4, 5, and 6 and the stocking rates used are shown in Table 1.

Defoliation patterns were determined during the January to May grazing periods by regular monitoring of and sampling from a minimum of 10 sites per defined site type. Concomitantly samples of ryegrass tillers were taken from the various types of site to assess the levels and distribution of the ryegrass endophyte, *A. loliae*, and the lolitrem neurotoxins within the pasture. The endophyte assessments were made using the enzyme-linked immunosorbent assay (ELISA) detection system (Musgrave, 1984).

TABLE 1 Days since urine-deposition of the different urine patch (UP) categories at the start of grazing periods 4, 5 and 6 and the stocking rates used.

	GRAZING PERIOD		
Site	4 21–28 Feb	5 28 Mar–5 Apr	6 22–29 Apr
UP1	88		
UP2	35	70	95
UP3		30	55
UP4			20
Stocking rate (sheep/ha)	84	84	72

RESULTS

Ryegrass tiller densities were higher at UP sites and lower at IEWC sites than at IE and DP sites. UP covered about one-third and DP about one-quarter of the pasture area in period 5 (Table 2).

A much higher proportion of the *A. loliae* within the ryegrass components examined (viz. live and dead leaf blade, sheath and flowering stem) was contained in the live sheath component of UP (70 to 85%) than IE (42%) or DP (42%) tillers.

Concentrations of *A. loliae* in the live sheath component of ryegrass were generally much higher in the UP than IE tillers (Table 3).

The greatest amount and proportion of ryegrass leaf blade removed per tiller during grazing periods 4, 5 and 6 was from the most recent UP category on each occasion (Table 4). By period 4, UP1 sites were 3 months old and had reverted back to IE status. There was no defoliation at DP sites before grazing period 6 and then only about one-quarter of the leaf blade was removed. IE sites were generally only lightly defoliated whereas most of the ryegrass leaf blade at IEWC sites was removed at each grazing.

A much higher proportion of the ryegrass tillers at UP sites had live sheath defoliated than did those at IE sites (Table 5). Within the UP categories the highest proportion of ryegrass tillers with live sheath defoliated was always in the most recent category.

TABLE 2 % pasture area covered by different types of excreta site and ryegrass tiller densities at these sites in period 5.

Site	% area covered	Relative tiller density
IEWC	15	25
IE	27	60
DP	23	55
UP2	35	100
UP3		95

TABLE 3 *A. loliae* concentrations (μg mycelium wet wgt/mg plant material dry wgt.) in live ryegrass sheath from interexcreta (IE) and urine patch (UP) sites.

Period	IE	UP2	UP3
4	5	58	
5	9	4	12
6	2	13	10

TABLE 4 Live ryegrass leaf present before and after grazing (cm/tiller) on interexcreta (IE, IEWC) urine patch (UP) and dung patch (D) sites.

Grazing Period		IE	UP1	UP2	UP3	UP4	DP	IEWC
4	Before	13.3	13.8	47	/†	/		
	After	12.2	10	3.5	/	/		1.9
5	Before	17.2		16.6	22	/		
	After	13.3		6	3.8	/	24.3	2.6
6	Before			11.4	17.5	25.1	31.5	7.9
	After	9.6		4.0	3.2	2.5	23.4	2.6

† Slash indicates that site type did not exist at time of observation.

TABLE 5 % ryegrass tillers with live sheath eaten on interexcreta (IE) and urine patch (UP) sites.

Period	IE	UP2	UP3	UP4
4	5	60	/†	/
5	10	20	45	/
6	5	45	55	70

† Slash indicates that site type did not exist at the time of observation.

RGS only occurred during grazing period 5, when mild symptoms were noted in 5 of 34 sheep.

Lolitrem concentrations have yet to be determined for the samples taken.

DISCUSSION

The defoliation pattern results from this study extend those reported for earlier studies on similar pastures (Keogh, 1973a; 1975). Not only were differences in defoliation of ryegrass components by sheep detected between UP sites and other types of site, but differences were also detected within the UP categories monitored. The more recently formed UP were grazed sooner and to a greater extent than were older UP. The higher proportion of ryegrass tillers from the most recent UP sites that had live sheath removed reflects this pattern.

The rejection of dung-patch herbage by sheep was not unexpected but the extent and duration of the effect were. The herbage present on nearly 25% of the pasture was not acceptable to sheep for 5 months. This period extends beyond the limits within which the development of RGS usually occurs and this suggests that irrespective of the neurotoxin levels within DP herbage it is not likely to be a major source of toxin acquisition.

The results for the distribution of *A. loliae,* show that there is considerable site to site variation. As has previously been found for some other pasture fungi (see introduction), *A. loliae* has developed better within the higher nitrogen sites viz. urine-patch sites. This may reflect a high N requirement for its rapid and sustained development. The drop in *A. loliae* concentrations in the live sheath of ryegrass within UP2 sites from period 4 to periods 5 and 6 may reflect seasonal changes in *A. loliae* development as well as N-depletion within the site and consequent reduced N-uptake.

It has been suggested that neurotoxicity is greater in ryegrass growing at high N sites (Keogh, 1978). If neurotoxin production is a function of *A. loliae* activity then it may be expected that neurotoxin levels would be higher in ryegrass at UP sites than elsewhere in the pasture. If this proves to be the case, then it follows as a consequence of the defoliation pattern results that the major source of neurotoxins acquired by sheep grazing ryegrass-dominant pastures is from UP sites. Control over acquisition of neurotoxins is then very much a question of controlling the defoliation that occurs at these sites.

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