

Application of the Double-Normal Distribution to Measurements of Sward Height for Kikuyu Pastures Grazed by Dairy Cows at Different Grazing Durations

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Sward height (SH) distributions are frequently summarised by the sample mean and standard error. This is most appropriate when the population distribution is approximately symmetrical. However, in continuously grazed swards a combination of relatively 'short' and 'tall' patches in pasture are created and maintained by cattle through selective grazing (Edwards *et al.* 1997). The relative proportions of 'short' and 'tall' areas are largely affected by management factors such as grazing intensity and the length of the grazing session. Sward heterogeneity is important for a number of reasons. It will affect subsequent utilisation by grazing animals which may in turn affect patterns of nutrient return and treading damage. It may also affect inter-plant competition and potentially the species composition of the sward in the long term. Frequencies of SH usually show a skewed distribution and the representation of a single mean SH is potentially misleading (Gibb and Ridout 1986).

Sward height data from an experiment designed to measure the behaviour of dairy cows grazing kikuyu pastures at two different sward heights (SH: 10 and 13 cm) and grazing durations (1, 2, 4, 8 and 15h) was used to determine the ability of a double-normal (DN) distribution to describe changes over the grazing treatments in the mean heights of the 'short' and 'tall' components of the sward. To determine pasture profiles within a treatment combination, 20 pre-grazing rising plate meter (RPM) measurements/paddock were taken each day before cows entered their allocated paddock. In addition 20 post-grazing RPM measurements/paddock were taken 3h after the last grazing duration treatment so that pasture had time to recover from treading. These measurements were taken along a diagonal transect within each treatment paddock at approximately 30 cm apart. The post-grazing data contained 60 observations from the distribution of pasture height after 1, 2, 4, 8 and 15h of grazing. The DN distribution can occur when a proportion, p , of the population is normally distributed with mean μ_1 and variance, σ_1^2 and a proportion $(1-p)$ is normally distributed with mean μ_2 and variance, σ_2^2 .

The proportion that was 'tall' (p) changed after the first 2h of grazing for both SH treatments, suggesting that cows preferred pasture of short to medium height initially. This would indicate that the cows did not graze at random. As grazing progressed, the structure of the swards between SH treatments differed such that two distinct populations of SH were evident (Table 1).

Table 1. Parameter estimates after fitting the double normal distribution to frequencies of sward height at 10 and 13cm grazed at different durations (1, 2, 4, 8 and 15h).

Parameter	Initial Compressed sward height (cm)									
	10					13				
	Grazing duration (h)									
	1	2	4	8	15	1	2	4	8	15
p^*	0.37	0.63	0.09	0.24	0.74	0.17	0.30	No	0.73	0.26
μ_1	12.0	9.5	12.6	9.0	7.2	18.0	11.1	fit	9.1	12.2
σ_1	2.9	3.0	4.3	4.2	2.4	2.5	3.9		2.7	5.7
μ_2	7.4	5.9	6.8	6.2	4.8	9.9	8.0		5.7	6.8
σ_2	1.8	0.8	2.0	1.4	0.2	2.0	2.1		0.8	2.2

* p is the proportion of sward that is 'tall'

The DN distribution can be used to describe pastures that have been intensively grazed by dairy cows and be used to assess the changes in sward structure more accurately than just presenting the mean.

Edwards, G.R., Newman, J.A., Parsons, A.J. and Krebs, J.R. (1997) *Appl. Anim. Beh. Sci.* **51**, 59-68.

Gibb, M.J. and Ridout, M.S. (1986) *Grass and Forage Science.* **41**, 247-249.

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