MEASURING SPATIAL VARIATION WITHIN PASTURES

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ABSTRACT

Paddock means of pasture yield and composition can be inadequate or even misleading due to the spatial variability within pastures. The use of visual estimation procedures, particularly the BOTANAL technique, provides data suitable for analysing variability as many quadrats are sampled within the one paddock. Examples show how data from routine BOTANAL samplings can reveal small and paddock scale spatial variation, and how BOTANAL data can be used to examine relationships between the yield of legume and grass in a mixed pasture grazed at different stocking rates.

KEYWORDS

Pasture variability, Botanal, botanical composition, yield

INTRODUCTION

Conventional pasture descriptions are based on paddock means and are often used to derive relationships between pasture and other attributes such as soil type, dominant species or animal production. However, these paddock means take no account of spatial variability within pastures. This can occur at different scales; the land class scale (large, e.g. 300 m or more), patch grazing scale (intermediate, 2-20 m) and the individual plant scale (small, 20-100 cm). Because of this variability, the means themselves and relationships between pasture and other attributes, derived from paddock means, can be inadequate or even misleading.

The BOTANAL procedure of field sampling (Tothill *et al*., 1992) and data collection and processing (Hargreaves and Kerr, 1992; McDonald *et al.*, 1996) can be used to study variability in grazed pastures. In routine sampling this procedure typically involves the estimation of 30 - 100 quadrats per paddock. As well as calculating paddock means over these quadrats, BOTANAL can examine variability between different quadrats in yield, species composition and other attributes (eg. ground cover). It also allows other factors such as aspect, slope position, soil type and patch grazing to be recorded and grouped into categories. Summaries of species composition and other attributes, and number of quadrats, can then be determined for each category. If data is collected on a fixed grid layout then spatial variability of attributes can be mapped. This paper gives two examples of how routine BOTANAL sampling data can be analysed to examine spatial heterogeneity and temporal variation. Another example examines the yield relationships between the two dominant species in a mixed pasture.

SPATIAL VARIABILITY

Example 1. The ability of BOTANAL to document the effect of topography on species composition has been shown by McDonald and Hodgkinson (1996). A 14 ha paddock was sampled with 420 quadrats in a fixed grid. Individual quadrats were allocated to three land classes (upper, middle and lower slope) within the paddock. Mean yield and composition were calculated for each land class and the whole paddock. The land class values gave great insight into the distribution of species within the paddock. For example, the mean paddock % contribution for *Arundinella nepalensis* was 21% but its contribution in the upper, middle and lower sections was 0, 11 and 66% respectively. In contrast, the contribution of Seca stylo (*Stylosanthes scabra*) was 14, 5 and 3% on the same land classes, and 5% overall.

Example 2. Figure 1 presents data from a spring BOTANAL sampling of 400 quadrats (20 x 20 cm) pooled over 8 paddocks in an experiment described by Jones (1982). It shows the strong negative relationship between the stand-over yield of Bahia grass (*Paspalum notatum*) from the previous summer and the presence of white clover (*Trifolium repens*) in spring. As environmental factors such as rainfall and temperature affect the presence of white clover (Jones, 1982), it is to be expected that the actual level of the frequency:yield relationship would vary from year to year. However, the shape of the curve was the same in each year. While the overall beneficial effect on clover persistence of extra grazing pressure over summer had been shown with two grazing treatments by Jones (1982), Figure 1 gives much better insight into the effect of a wide range of Bahia grass yield on clover persistence and the need for close grazing over summer to maintain white clover with a C_4 companion grass. This example has been used in a different context by McIvor *et al*., (1993).

INTERSPECIFIC RELATIONSHIPS

Pasture presentation yield data collected from pastures in a grazing trial in south-east Queensland were analysed on an individual quadrat basis. Pastures of buffel grass (*Cenchrus ciliaris*)-roundleaf cassia (*Chaemachrista rotundifolia*) cv. Wynn were grazed by heifers at 2 stocking rates (0.54 and 0.73 animals/ha) with 2 replications. Estimations of the total yield of the quadrat and the percent composition of buffel grass, legume, other dicot and other monocot were made in 48 quadrat (0.5 x 0.5m) per paddock. The data was then grouped into 10 classes, based on the calculated yield of buffel grass in each quadrat. The legume yield was then determined for each class.

The mean buffel grass and cassia yields for the lower stocking rate were 5300 and 490 kg/ha and 2590 and 700 kg/ha for the higher rate. The yield of other species was minimal. As there was little effect of stocking rate on animal liveweight, the grazing pressure was 70% higher at the higher stocking rate.

Cassia yields declined linearly with increasing buffel yield at both stocking rates (Figure 2) . The different paddock mean yields but identical slopes reflect the different distribution of buffel grass yields within paddocks at the two stocking rates. There were fewer high yielding buffel grass quadrats at the higher stocking rate than at the lower stocking rate, hence the greater mean cassia yield at the higher stocking rate.

The results suggest that grazing pressure had little effect on cassia yield apart from the impact that it had through its effect on buffel grass. We conclude from this that, at the time of sampling, cassia was not being appreciably eaten otherwise the relationships for the two stocking rates would be different.

The trend lines intercept the x-axis (zero legume yield) at buffel yields around 4000-5000 kg/ha and the same intercept was obtained from a similar analysis of pastures of shrubby stylo and buffel grass at the same site (data not presented). This indicates that, in this environment, buffel yields need to be kept below this level to maintain these legumes. Conversely, buffel yields need to be kept above a level where the legumes could become dominant. Due to the variability, it would be impossible to maintain the entire paddock at a particular yield. However, in this situation keeping the majority of the buffel at a yield around 2-3000 kg/ha should ensure legume persistence and yield.

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Figure 1
Frequency of occurrence of white clover in 20 x 20 cm quadrats in relation to Bahia grass yield in the same quadrats, in spring of three years.

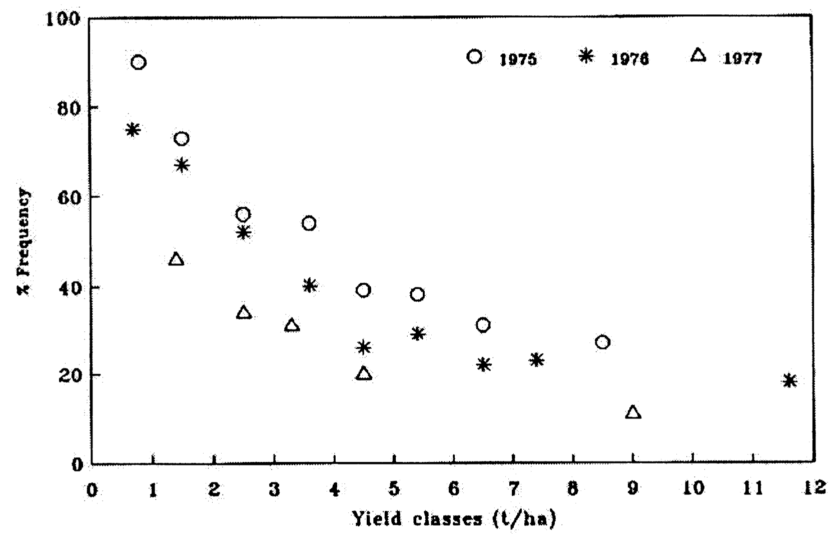

Figure 2
Trend lines within paddocks at two stocking rates for cassia yields vs buffel grass yield classes in the same quadrats.