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Diet-Quality Considerations in the Design and Management of Pastures in Seasonally Dry Tropics of Australia

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Summary

Much of Australian tropical-pasture research in the last 20 years has been aimed at filling the "protein gap" of the dry seaso with a well-adapted legume. Several such legumes are now available, but their contribution to an improved nutritional regime has been variable. This paper puts forward generalizations as to the contribution of pasture components to cattle nutrition an attempts to apply this information in devising regional strategies for pasture design and management.

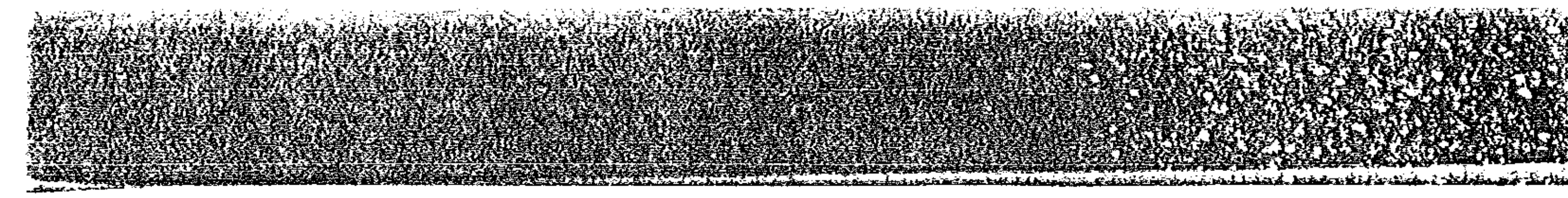
The contribution of a forage component is a function of (1) its nutritive value and (2) its relative acceptability. Thre components emerge as both highly nutritious and acceptable—i.e, young green grass, mature green legume, and legume litte (mainly leaf and seed).

Young grass dominates the diet from first storms until late in the rainy season. Drastic reduction in grass quality correspond to peak yields of mature green legume, and diet composition changes correspondingly. Green legume remains the major di component until soil water depletion triggers senescence and leaf shed.

During the dry-feed period, legume litter is capable of supporting live-weight gain unless rainfall causes spoilage. Sufficien rain to promote substantial grass growth can also have a net benefit. The most deleterious situation is one of small rainfalls, su ficient to cause spoilage but insufficient to support growth. Dry-season rainfall in the beef-producing regions of tropica Australia is highly variable, both geographically and temporally. Figures are presented that show (a) the variation in risk o rainfall damage to dry legume and (b) the probability of green grass availability. These provide a basis for design of pastures an management for various regions. Strategies for two contrasting environments are discussed.

Although the goal of a well-adapted, high-yielding pasture legume for the subhumid to semiarid tropics has been achieved there remains a major task in optimizing utilization of such a plant in production systems over a wide range of environment

KEY WORDS: tropical pastures, pasture legumes, *Stylosanthes,* beef cattle, diet selection, agro-climatology.



INTRODUCTION

The nutritional status of cattle on grasslands in the seasonally dry tropics cycles in phase with the seasonal cycle of rainfall. The nutritive value of tropical-grass leaf tissue declines drastically as the leaf ages (Wilson and 't Mannetje 1978), and live weight increases only during periods of grass growth (McCown 1981). In contrast, the quality of tropical-legume leaf declines little with age (Norman 1964), and even dry senesced leaf can support gain in cattle weight (Norman 1970). For this reason, much of the Australian tropical pasture research of the last 20 years has been aimed at filling the "protein gap" in the dry season with a well-adapted legume (McIvor et al. 1982). Several such legumes are now available, but their contribution to an improved cattle nutritional regimen has varied greatly. This paper draws on recent findings in generalizing the relative contribution to improved diet quality of the major herbage components in pastures of perennial grass and legumes of the genus *Stylosanthes*. It attempts further to apply this model in devising regional strategies for pasture design and management within the seasonally dry tropical zone.

PASTURE COMPONENTS OF DIETARY IMPORTANCE

From the onset of the growing season, cattle select a high-quality diet composed mainly of young grass, which is preferred to young legume tissue (Gardener 1980). Late in the growing season when grass quality declines during flowering, grazing preference shifts to the now-mature legume, whose nutritive value is enhanced by developing seed. Rates of live-weight gain, which fall at this time on native pastures, remain high as long as amounts of green legume leaf and seed are ample (Gardener 1980). As the soil dries out, growth ceases, and existing leaves senesce and are shed (McCown et al. 1981b). The rate of green leaf decline varies greatly among legume species (McCown and Wall, unpublished). In the absence of rain, dry leaf is readily licked up by cattle along with seed, providing a diet capable of supporting weight gains (Norman 1964, 1970). However, rainfall sufficient to mold the dry leaf litter results in a change of diet to mainly low-quality dry perennial grass, with consequent weight loss (Gardener 1980). If rainfall is sufficient, new green grass again becomes important in the diet, and cattle gain weight for a time; however, at this time legumes make a negligible contribution because of slow growth and low acceptability of new tissue (Gardener and McCown, unpublished).

It can be concluded, therefore, that in this environment three pasture components are both of high nutritive value and readily acceptable to cattle: young green grass, mature green legume, and nonmoldy legume litter (mainly leaf and seed). It follows that pastures should be designed and managed to optimize supply of these components.

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REGIONAL VARIATION IN DRY-SEASON CLIMATE AFFECTING CATTLE NUTRITION

Dry-Season Length

A dry season is defined using a weekly pasture growth index; it corresponds to that portion of the year outside the main period of live-weight gain of cattle on native grass pastures (McCown 1981). Median values for the main beef-producing area of tropical Australia range from 10 to 28 weeks (Fig. 1).

Proportion of Dry Season Capable of Preserving Dry Legume

The deferred grazing of legume pasture until the dry season is an obvious strategy for reducing the impact of this dormant season. The duration of the contribution depends to a large degree on the time of occurrence of weather conditions that cause molding sufficient to reduce markedly acceptability of dry legume to cattle. The potential of various regions for preserving dry-legume quality can be compared (Fig. 2). This figure is based on simulated dry-season changes using models of McCown et al. (1981b) and McCown and Wall (1981) in which rainfall and potential evaporation drive the processes of leaf shed and molding. The climates at Darwin and Katherine are most favorable for this strategy, with no serious molding for the entire dry season in 6 to 7 years out of 10. In only 15% of years can the "good" period be expected to be less than half of the entire dry season. Weipa, Normanton, Wrotham Park, and Derby are progressively less favorable. At Woodstock the probability of dry legume's making a substantial contribution is less than 1 year in 10. In 5 years in 10, dry legume is valueless from the outset, having molded during leaf shed.

Pulses of Growing Conditions in Dry Season

Any beneficial effect of the dry-season rain depends on the duration of subsequent favorable growing conditions. Variation among sites is shown in Fig. 3. The variable is

Fig. 1. Map of median dry-season length (weeks).

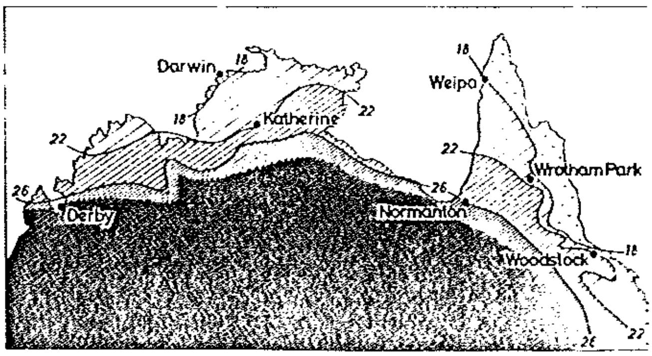


Fig. 2. Cumulative frequency distribution of the proportion of the dry season prior to serious molding of dry legume for stations identified and located in Fig. 1.

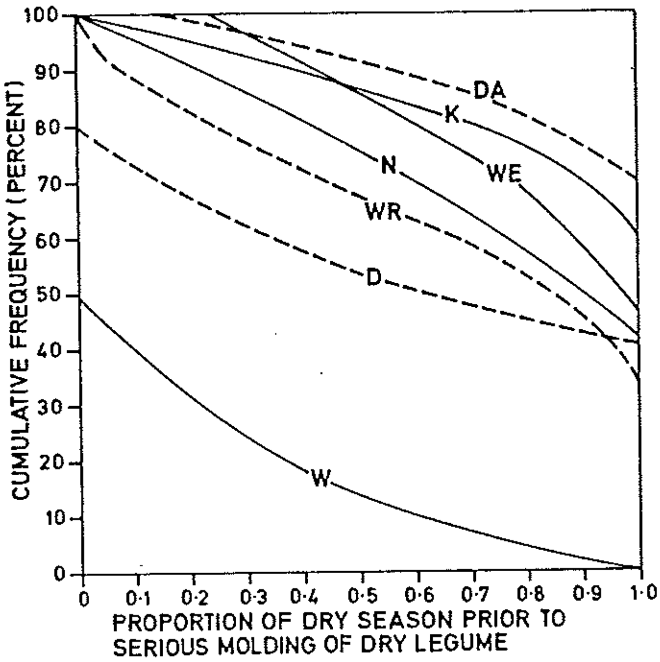
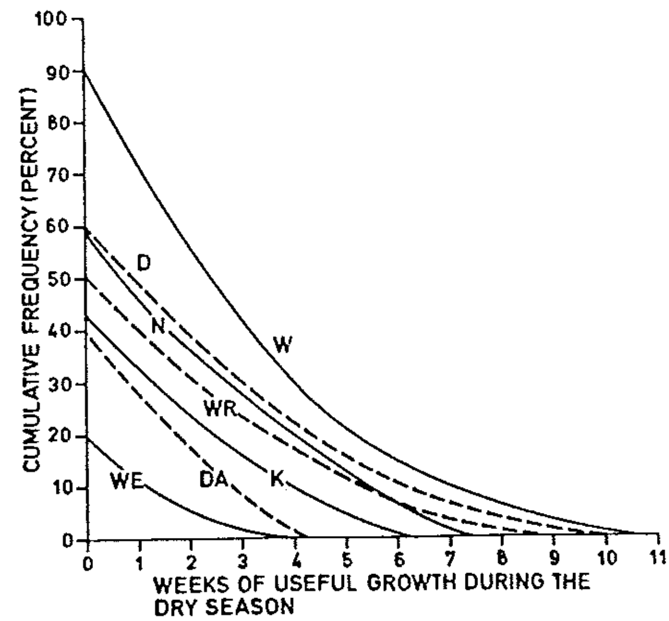


Fig. 3. Cumulative frequency distribution of the number of weeks of useful growth in the dry season for stations identified and located in Fig. 1.



the number of weeks when the growth index exceeds 0.1 – i.e., "green weeks" (McCown et al. 1981a). At the lower latitudes there is little expectation of rain and useful growth in the dry season. In the southeastern region, represented by Woodstock, pulses of pasture growth conditions are sufficiently common to be an important consideration in pasture design and management.

PASTURE DESIGN AND MANAGEMENT FOR DIFFERENT REGIONS

In the seasonally dry tropics of Australia, generally wherever a legume has been successfully established in native grassland and some minimal superphosphate applied, carrying capacity has increased, and the period of live-weight gain has been extended (McIvor et al. 1982). Recent research has, however, demonstrated that optimum design and management of pastures differ in major ways within this area.

Where the dry season is reliably dry (represented by Darwin, Katherine, and Weipa), senescence of deciduous legume at the end of the rainy season is rapid (McCown et al. 1981b). Because of a low molding risk, dry-season animal production is proportional to the quantity of dry legume (Norman 1970). Here grazing of pure legume pasture can be deferred until the dry season, allowing utilization of abundant native grass pastures when they are green. Although this strategy failed a decade ago because of the inability of Townsville stylo (*Stylosanthes humilis*) to compete with annual grasses, Caribbean stylo (*S. hamata*) has since proved to be much more competitive. An evergreen legume, i.e., *S. scabra* (Shrubby stylo), has not shown any nutritional superiority over the deciduous Caribbean stylo, and its substitution for Carribean stylo has some ecological drawbacks (W. Winter and J. Mott, personal communication).

In regions with more dry-season moisture (e.g., Woodstock), senescence is generally slower because of lower potential evaporation rates (McCown et al. 1981b). Legume litter is rarely consumed because it is generally too moldy or is mixed with other moldy or otherwise unacceptable residues (Fig. 2). In this environment, deferred grazing increases risk of spoilage, so legume should be consumed while it is green. A substantial perennial grass component is needed to provide a readily acceptable, although low-quality, bulk of feed in the dry season and to provide the prospect of some high-quality green growth in the event of dry-season rains. An intimate physical association of grass and legume can lead to greatly enhanced grass growth resulting from nitrogen from the legume (Gardener 1980). Here, use of evergreen legume species extends the duration of live-weight gains in the dry season beyond that of Caribbean stylo (Gardener, unpublished).

CONCLUSION

Until recently, the lack of well-adapted legumes for the seasonally dry tropics was the major barrier to legume-based agriculture in these regions. Although the search for new legumes for this climate continues, there is now an urgent need for increased understanding of how best to utilize the legumes at hand. Sound technology transfer is jeopardized by failure to give due consideration to variation in dry-season climate within this global climatic zone.

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