THE EFFECT OF LONG-TERM GRAZING TREATMENTS ON THE ESTABLISHMENT OF WOODY PLANTS IN A SOUTHERN AFRICAN SAVANNA

G.N. Smit[1] and N.F.G. Rethman[2]

[1]Department of Grassland Science, University of the O.F.S, P.O. Box 339, Bloemfontein 9300, Republic of South Africa
[2]Department of Plant Production and Soil Science, University of Pretoria, Pretoria 0001, Republic of South Africa

ABSTRACT

Eight paddocks which were debushed to an open savanna during 1935/36 and subsequently grazed annually during different seasons by steers were surveyed after a period of 54 years. Though woody plants have increased in all the paddocks, regardless of the grazing treatment, the rate of woody plant establishment was notably higher in those paddocks that received a more intense annual grazing treatment. This effect was most noticeable in those paddocks of which the mean Animal Unit-grazing days ha^{-1} exceeded 100 days annually. These results confirm the existence of a positive linear relationship between the severity of the grazing treatment and the rate at which woody plants have increased.

KEYWORDS

Animal Unit grazing days, bush encroachment, canopy cover, competition

INTRODUCTION

Formulation of acceptable long-term grazing management strategies requires a sound understanding of the effect of domestic livestock on natural veld under different grazing systems (Smit and Rethman, 1992). This is complicated by dissimilar responses of different plant communities to the same grazing management impact. The long-term effect of cattle on natural veld is seldom simple and a direct influence may cause various indirect inter-related floristic changes. The effect of grazers on the rate of woody plant establishment is of particular importance and it is commonly believed that overgrazing is a major contributing factor towards an increased rate of woody plant establishment (bush encroachment). The objective of this study was to determine the effect of different long term grazing treatments on the establishment of woody plants in a southern African savanna.

MATERIALS AND METHODS

Study area. This study was conducted on the Towoomba Agricultural Development Centre in the Northern Province of South Africa (28°21'E, 24°25'S; 1 184 m above sea level). The savanna vegetation is described as Sourish Mixed Bushveld (Acocks 1988). The dominant tree species are *Dichrostachys cinerea, Acacia karroo, A. tortilis* and *A. nilotica* and the most important grass species are *Panicum maximum, Eragrostis rigidior, Digitaria eriantha, Heteropogon contortus, Themeda triandra* and *Schmidtia pappophoroides*.

The climate is subtropical with a mean long-term seasonal rainfall of 620 mm. Rainfall usually occurs from October to March, but is unpredictable and irregularly distributed. Mean daily maximum and minimum temperatures during December were 30.2°C and 17.6°C respectively, while during July they were 21.0°C and 3.0°C respectively. During June and July light frosts may occur.

The soil was of the Hutton form (MacVicar *et al*. 1977), and three soil series were identified viz. Shorrocks (-) (15-25% clay), Shorrocks (+) (25-35% clay) and Makatini (35-45% clay). The Shorrocks (-) series extended over 80% of the study area.

Trial lay-out and treatments. The study area comprised of eight paddocks (allocated to four grazing systems) which were subjected to fixed seasonal grazing treatments (Table 1). The beginning and end of each season was based on certain phenological growth stages of indicator grass and tree species. At the commencement of the trial (1935/36) the study site was debushed to an open savanna (Irvine, 1941). Paddock sizes, grazing treatments, months of utilization, mean long-term duration of the different seasons, mean long-term stocking density, mean long-term animal unit (AU)-grazing days ha^{-1} (total and growing season), are summarized in Table 1. On average the growing season commences during early October and ends towards the end of April (212 days). Animal Unit-grazing days ha^{-1} were calculated as the mean period of occupation (total and growing season) x mean stocking density (AU ha^{-1}).

The combined area of each grazing system was grazed by two Afrikander-type steers. The mean long-term AU-value represented by each experimental animal was calculated as 0.93 (Meissner *et al*. 1983).

Botanical surveys. The height of all rooted live woody plants within nine stratified random transects of 2 x 70 m per paddock was measured. It was also noted whether they were multi-stemmed or not. A Tree Equivalent (TE)-value (Teague *et al*. 1981) was calculated for each tree (1 TE = single stemmed tree 1.5 m high). In order to compensate for differences in the biomass of single-stemmed and multi-stemmed trees the TE-values of multi-stemmed trees were multiplied with a factor of 1.5. For each paddock the number of TE per hectare was calculated.

The percentage canopy cover of woody plants within each paddock was estimated using a technique as described by Westfall and Panagos (1984).

RESULTS AND DISCUSSION

Due to the soil of paddock 1 that differed from that of the rest of the study area this paddock was excluded from the evaluation. The number of TE ha^{-1} and the percentage canopy cover in combination with the mean number of AU-grazing days ha^{-1} (total and growing season) are comparatively illustrated in Figure 1. The number of TE ha^{-1} as well as the percentage tree canopy cover were found to be positively correlated with the number of AU-grazing days ha^{-1}:

(i) Total AU-grazing days ha^{-1} and TE ha^{-1}: $r = 0.678$ ($P<0.05$)
(ii) Total AU-grazing days ha^{-1} and Canopy cover (%): $r = 0.912$ ($P<0.01$)
(iii) AU-grazing days ha^{-1} during growing season and TE ha^{-1}: $r = 0.750$ ($P<0.05$)
(iv) AU-grazing days ha^{-1} during growing season and canopy cover (%): $r = 0.750$ ($P<0.05$)

These results confirm the existence of a positive linear relationship between the severity of the grazing treatment and the rate at which woody plants have increased over a period of 54 years. Though it is clear that woody plants have increased in all the paddocks, regardless of the grazing treatment, the rate of woody plant establishment was notably higher in those paddocks that received a more intense annual grazing treatment. This effect was most noticeable in those paddocks of which the mean AU-grazing days ha^{-1} exceeded 100 days annually (paddocks 3 and 7).

Smit and Rethman (1992) concluded that most of the floristic changes that occurred in the study area as a result of the different long term grazing treatments can be attributed to the severity of grazing during the growing season in particular. Differences in the effect of grazing

predominantly during the growing season versus the effect of grazing predominantly during the dormant season was less visible in terms of the woody plant establishment.

It would appear that any grazing treatment which drastically reduces the grass cover at any point in time would allow, to a greater or lesser extent, the formation of areas suitable for the establishment of woody plant seedlings. These results confirm the common belief that prolonged severe grazing, in the absence of other determinants of woody plant density like browsers or fire, favoured an increased rate of woody plant establishment. Woody plant seedlings are susceptible to competition from a vigorous grass layer during the early stages of their establishment and it can be assumed that the longer the period that severe grazing reduce the competitive ability of the grasses the better the chances of their survival.

REFERENCES

Acocks, J.P.H. 1988. Veld types of South Africa. 3rd edition. Memoirs of the Botanical Survey of South Africa 57.

Irvine, L.O.F. 1941. The major veld types of the northern Transvaal and their grazing management. Unpublished quinguennial report. Towoomba Research Station, Warmbaths.

MacVicar, C.N., J.M. De Villiers, R.F. Loxton, E. Verster, J.J.N. Lambrechts, R.F. Merryweather, J. Le Roux, J.A. Van Rooyen & H.J. Harmse von M. 1977. Soil classification: a binomial system for South Africa. 1st Edition. Soils and Irrigation Research Institute, Pretoria.

Meissner, H.H., H.S. Hofmeyr, W.J.J. Van Rensburg and J.P. Pienaar. 1983. Classification of livestock for realistic prediction of substitution values in terms of a biologically defined Large Stock Unit. Tech. Comm. No. 175. Dept. of Agriculture, Pretoria.

Smit, G.N. and N.F.G. Rethman. 1992. Inter-related floristic changes associated with different long-term grazing treatments in Sourish Mixed Bushveld. J. Grassld. Soc. sth. Afr. **9**: 76-82.

Westfall, R.H. and M.D. Panagos. 1984. A cover meter for canopy and basal cover estimations. Bothalia **15**: 241-244.

Figure 1

The number of (a) Tree Equivalents (TE) ha^{-1} and (b) the percentage canopy cover comparative to the mean number of Animal Unit (AU)-grazing daysha^{-1} (total and growing season).

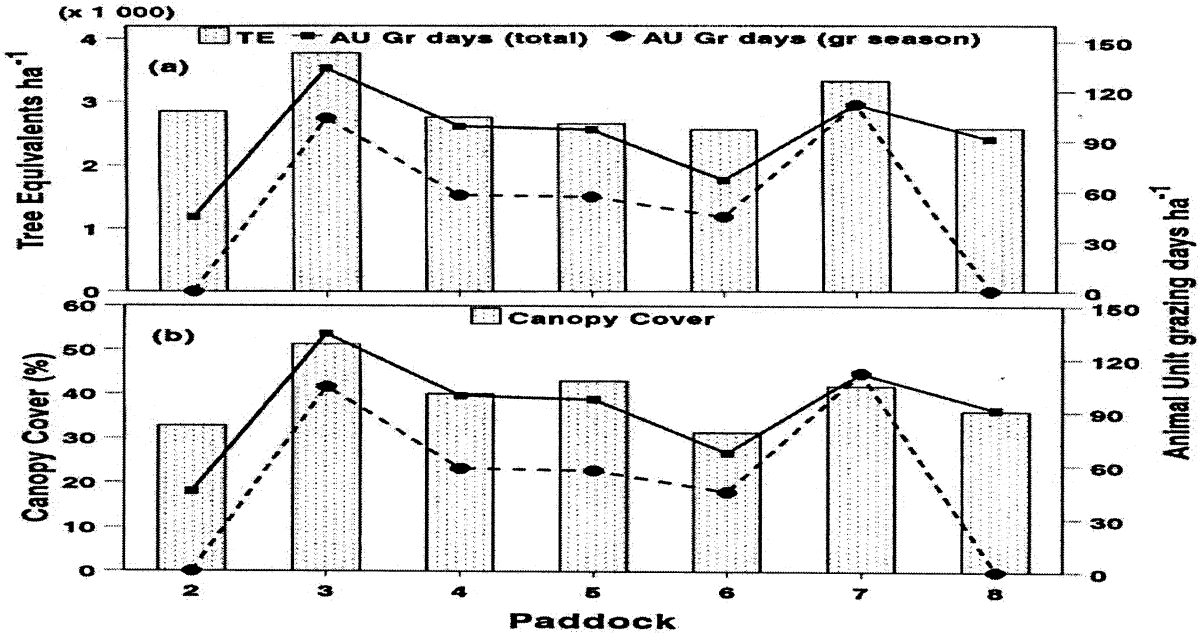

Table 1

Paddock sizes, grazing treatments, months of utilization, mean long-term duration of the seasons, mean long term stocking density and mean long-term AU-grazing days ha^{-1} (total and growing season) (Smit and Rethman, 1992).

Grazing system	Paddock	Paddock size (ha)	Grazing treatment	Month of utilization	Duration (days)	Stocking density (AU ha^{-1})	AU-grazing days (days ha^{-1})	
							Total	Growing season
1	1	7.590	Continuous grazing	Full year	365	0.25	91	53
2	2	3.795	Winter only	June-Sept	92	0.49	45	0
2	3	3.795	Spring, summer, autumn	Sept-June	273	0.49	134	104
3	4	3.795	Mid winter - mid summer	Mid Jul-mid Jan	184	0.54	99	58
3	5	3.795	Mid summer - mid winter	Mid Jan-mid Jul	181	0.54	97	57
4	6	2.530	Spring only	Sept-Dec	91	0.74	67	45
4	7	2.530	Summer only	Dec-May	151	0.74	112	112
4	8	2.530	Autumn, Winter	May-Sept	123	0.74	91	0