Competition for Light in a *Leucaena leucocephala / Chloris gayana* Silvopastoral System

N. F. G. Rethman
University of Pretoria, South Africa

J. P. Lindeque
University of Pretoria, South Africa

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COMPETITION FOR LIGHT IN A *Leucaena leucocephala / Chloris gayana* *SYLVOPASTORAL SYSTEM*

NFG Rethman and JP Lindeque

Department of Plant Production and Soil Science,

University of Pretoria, Pretoria 0002, South Africa

nrethman@postino.up.ac.za

Abstract

The spatial variation in the vigour of Leucaena *(Leucaena leucocephala* cv. Cunningham) trees growing together with Rhodesgrass (*Chloris gayana* cv. Katambora) in an alley cropping system made it possible to assess the competitive effect for light. The height and especially lateral development of trees had a strong influence on light interception by the canopy, with radiation in the intercrop area being 49% lower where the trees were more vigorous. There was a corresponding (43%) decrease in grass production. These findings indicate that future studies should also include aspects such as espacement of trees, pruning of trees in the growing season, choice of shade tolerant grasses and the competitive effect for water.

Keywords: Forage production, Leucaena, light interception, Rhodesgrass, tree structure .

Introduction

Where grass and tree forage crops are combined there have always been arguments about the competitive and complementary effects of such components. In a Leucaena/Rhodesgrass pasture, with a standard espacement, spatial variation in the vigour and canopy cover of the woody component, over the experimental area, presented the opportunity of determining whether light interception by the Leucaena canopy would have any effect on the productivity of Rhodesgrass.

Materials and Methods

In the 1992/93 season Leucaena (*L. leucocephala* cv Cunningham) seedlings were planted at an espacement of one metre in the row and three metres between rows on the Hatfield Experimental Farm of the University of Pretoria. Situated at 28^{o} 16'E and 25^{o} 45'S, at an altitude of 1372 m, the site receives an annual rainfall of 650 mm concentrated mainly in the summer growing season. While the summers are warm (mean maximum in November -February period 28^{o} C) the mean minimum temperatures in June/July are 4^{o} C with occasional severe frosts resulting in top-kill of Leucaena. The soil, classified as a sandy clay Hutton by McVicar et al. (1977), was well drained, had a pH of 6.7 and medium to high P, K, Ca and Mg status. In the 1993/94 season, after Leucaena had been pruned to a height of 0.3 m (to remove frosted topgrowth and to encourage coppicing), the inter-row was seeded with Rhodesgrass(*Chloris gayana* cv. Katambora) at a seeding rate of 12 kg ha $^{-1}$. Three months later – in the late summer – when it had become evident that there was considerable spatial variation in height and canopy cover of the Leucaena, and the productivity of the intercrop, it was decided to assess the degree of light interception and the productivity of the intercrop in the inter-row area at a range of sites. The light interception was measure at five heights (namely at soil surface (0.0 m, 0.5 m, 1.0m, 1.5 m and 2.0 m) in the middle of the inter-row (ie 1.5 m from

each row of trees), using a sunfleck Ceptometer [*] . Grass yields were determined on one metre square quadrats, clipped to a height of seven cm, in the middle of the inter-row. Clipped material was oven dried to constant mass to determine dry matter content and dry matter yields.

Results and Discussion

It rapidly become evident that the height of the tree canopy (Table 1) was not, on its own, a good measure of the competitive effect of Leucaena. Although there were minimal differences in height between more (A) and less (B) vigorous areas, the interception of light was significantly greater in the vigorous areas. On average radiation levels in the inter-crop area were half those in the less vigorous areas. This might be ascribed, in part at least, to the more vigorous lateral branching observed on the more vigorous areas, resulting in branches meeting overhead the inter-crop area. Other factors which might have played a role are : the east/west orientation of rows (as in this trial) in comparison with north/south row orientation; the growth form of this particular cultivar; the possible impact of increased coppicing – resulting in a multi-stem growth form – as a result of winter top-kill or winter pruning; the influence of growing season utilization, which did not take place in this trial. There are thus a series of factors which might affect the amount of radiation available for the inter-crop. Facets which deserve particular attention in follow-up trials should, therefore, include espacement of trees, orientation of rows and the pruning or utilization of the woody component during the growing season.

** Decagon Devices Inc, Pullman, Washington, USA*

The effect of the reduced radiation levels is well illustrated in Table 2. The production of Rhodesgrass was reduced by 43% where radiation levels were reduced by 49%. It is doubtful, however, whether this would be applicable to all situations, or species, as several studies (Wong and Wilson, 1980; Stuart-Hill et al., 1987; Ella et al., 1991) have indicated that differences in adaptation of species often results in better growth under a canopy than in open sunshine. This observation might, however, be confounded by other factors in the canopy micro-climate, such as soil fertility or the availability of water. In future investigations into the interactions between grasses and woody species special attention should, therefore, be paid to the choice of shade tolerent grass species, the possible role of fertility associated with the tree micro-climate and the possible interaction between shade, temperature and water.

References

Ella, A., Stür W.W., Blair G.J. and Jacobsen C.N. (1991). Effect of plant density and cutting frequency on the yield of four legumes and interplanted *Panicum maximum* cv. Riversdale. Trop. Grassl. **25**: 281-286.

MacVicar, C.N., Loxton R.F., Lamprechts J.J.N., Le Roux J., De Villiers J.M., Verster E., Merryweather F.R., Van Rooyen J.H. and Von M. Harmse J.H. (1977). Soil classification: A binomial system for South Africa. Dept. Agric. Tech. Serv., Pretoria, South Africa.

Stuart-Hill, G.C., Tainton N.M. and Barnard H.J. (1987). The influence of an *Acacia karoo* tree on grass production in its vicinity. J. Grassl. Soc, South Africa. **4**: 83-88

Wong, C.C. and Wilson J.R. (1980). Effects of shading on growth and nitrogen content of GreenPanic and Siratro in pure. and mixed swards defoliated at two frequencies. Austr. J. Agric, Res. **31**: 269-285

Table 1 - Photosynthetic radiation levels measured at different heights within the inter-crop area of a Leucana / Rhodesgrass alley cropping system

Vigour of Leucaena Component	Height of canopy (m)	Radiation levels at different heights :mol m^{-2} sec^{-1}					
		0	0.5	1.0	1.5	2.0	Mean
A+	1.40	100	98	286	601	881	393
A	1.29	531	638	888	1321	15181	979
B	1.18	1100	1153	1246	1376	1496	1274
B-	1.31	1238	1369	1427	1506	1516	1411

Table 2 - Dry matter yields of grass inter-crop in a Leucaena/Rhodesgrass alley cropping system, as influenced by the vigour of the tree component

Vigour of Leucaena Component	Radiation levels within the inter-row area :mol m^{-2} sec^{-1}	Height of canopy (m)	Grass yields (tha^{-1})
A	686	1.35	9.78
B	1342	1.25	17.23