Shade Tolerance of Some Tree Legumes

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Abstract

The shade tolerance of some commonly used tree legume species was compared in a glasshouse experiment at the University of Queensland in 1988. The treatments were 100, 70, 50, 30, and 20% of photosynthetically active radiation effected using shade cloth in a glasshouse. Shade tolerance was assessed by comparing yield at low light levels with that obtained at high light. Using this criteria, shade tolerance was assessed in the descending order *Gliricidia sepium* > *Calliandra calothyrsus* > *Leucaena leucocephala* > *Sesbania grandiflora* > *Acacia villosa* > *Albizia chinensis.*

PRODUCTIVE high quality forage species, adapted to shade environments, are required to improve the animal production of ruminants integrated into plantations crops. Most species that have been used for this purpose are herbaceous (Gutteridge and Whiteman 1978, Shelton et al. 1987). Shade-adapted legumes, in particular, are sought for inclusion in pastures because of their superior quality and their ability to contribute biologically fixed nitrogen to the plantation crop.

Several studies have reported the shade tolerance of herbaceous legume genotypes which may be suitable for use in plantation environments (Eriksen and Whitney 1982, Wong et al. 1985). However, very little attention has been directed to understanding the shade response of tree legumes, which may also be planted under perennial tree crops to provide additional shade or fodder for ruminants. One exception is the study of Egara and Jones (1977), who showed *Leucaena leucocephala* to have limited shade tolerance.

This study was initiated to provide information on the comparative response to shade of some commonly used fodder tree legumes.

Materials and Methods

A glasshouse experiment was conducted between April and August 1988 at the University of Queensland to compare the response of six fodder tree legumes to a range of light intensities. The experimental design was a complete randomised block in a split-plot arrangement with two replications.

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The main plots were 100, 70, 50, 30 and 20% of incident light transmission inside the glasshouse. Shade treatments were effected using a range of commercial shade cloths supported on plastic frames erected on benches. The glasshouse reduced incident light of all treatments by approximately 30%.

The six tree legumes evaluated were *Acacia villosa, Albizia chinensis, Calliandra calothyrsus, Gliricidia sepium, Leucaena leucocephala* and *Sesbania grandiflora.*

Two plants of each species were established in pots containing 4 kg of a red krasnozem soil obtained from the University of Queensland farm at Redland Bay. Pots were fertilised at fortnightly intervals to provide a total fertilizer application in kg/ha of 185 N, 61 P, 184 K, 125 Ca, 0.53 Cu, 0.18 Zn, 0.53 B, 0.35 Mn, 0.02 Mo and 0.05 Fe. Water was applied daily to pots to field capacity and fungicide was applied to inhibit fungal damage to young seedlings.

Plants were first grown for 25 days without shade cloth before the shading treatments commenced. These were continued for 70 days when plants were harvested, separated into leaf and edible stem (< 6 mm in diameter), stem and root fractions, and oven-dried at 60°C.

Results and Discussion

The mean dry matter yield response of the species showed a decline as the light level declined (Fig. 1). The mean yields were 42, 39, 32, 31 and 28 g/pot for the 100, 70, 50, 30 and 20% PAR treatments respectively. However, the extent of these effects varied among the species. Yields of *A. villosa, S. grandiflora* and *A. chinensis* were significantly reduced by shade; however, yield reductions in *L. leucocephala, C. calothyrsus* and *G. sepium* did not reach significance.

Fig. 1. Yield (DM g/pot) of tree legumes grown at five light levels.

When yield performance under all shading treatments was expressed as a percentage of yield at 100% light transmission, the relative order of shade tolerance was *G. sepium* (94%), *C. calothyrsus* (85%), *L. leucocephala* (84%), *S. grandiflora* (76%), *A. villosa* (70%) and *A. chinensis* (66%). When yield under very low light was examined, the relative yield performance of the species compared to 100% light transmission was *G. sepium* (92%), *C. calothyrsus* (78%), *L. leucocephala* (68%), *S. grandiflora* (62%), *A. villosa* (54%), and *A. chinensis* (48%).

The mean percentage of top growth ranged from 60-70% for all species with a trend towards less root growth at lower light levels (data not presented). Only in *A. villosa* was there a substantial increase in top yield relative to root yield at lower light levels.

These findings are in general agreement with those of Egara and Jones (1977), who demonstrated the moderate shade tolerance of leucaena, and with Egara and Jones (1977) and Wong et al. (1985) who showed increased root to shoot ratios under shade.

References

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