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Effect of Light Environment Experienced by the Parent Plant on the Establishment of *Brachiaria Decumbens* Stem Cuttings

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ABSTRACT

An experiment was conducted in a glass house at the University of New England, Armidale, N.S.W., Australia to investigate the effect on light environment of the parent plant on the establishment performance of *Brachiaria decumbens stapf.* The light treatments were 100% day light in the glass house (full day light), 60% and 30% of full day light.

Overall results demonstrated that the stem cuttings taken from full day light treatment produced higher number of tillers, larger leaf area and higher dry weights of tops and roots than the rest of the treatments. Stem cuttings obtained from 60% light treatment appeared to be superior to 30% light treatment. The results suggest that parent plants of *Brachiaria* species raised on young coconut plantations or on senile plantations would be more suitable as a source of planting material than those grown on mature plantations for commercial cultivation of grasses.

INTRODUCTION

It is well-established that light has a profound influence on herbage production and quality of pasture species (Black, 1956). Brougham (1956) reported that the growth and yield of a pasture was a function of leaf area up to a certain optimum leaf area index and hence of light interception. Furthermore, it is now well documented that the level of carbohydrate reserves and the contribution of new assimilates from current photosynthesis are the main factors controlling the rate of shoot and root growth (Jewiss, 1972). It has been reported that shade reduces the number and rate of appearance of grass tillers and legume runners of both temperate and tropical pasture species (Mitchell, 1953; Langer, 1963; Evans *et al*, 1964). It has also been reported that the shade tends to favour the utilization of carbohydrate reserves in the rhizomes of certain grasses (Troughton, 1951). In a previous experiment (Liyanage, 1980), it was revealed that there was a positive correlation between the growth of cuttings taken from basal parts of the culms of *Brachiaria nutica* and carbohydrate content. Based on these findings it is possible that the performance of stem cuttings during establishment can be influenced by the presence of carbohydrate reserves, which in turn may be influenced by the light conditions experienced by the parent plant. This study was initiated to determine the effects on the early establishment of stem cuttings of *B. decumbens.* taken from the parent plant, which had been subjected to different light environments. The three light levels chosen ranged from full day light, 60% and 30% of full day light, which approximate the light conditions under coconut at different stages of growth.

MATERIALS AND METHODS

The experiment was conducted in a glass house at the University of New England, Armidale, N.S.W. Australia where the average weekly means of maximum and minimum temperatures throughout the experimental period were around 30°C and 20°C while relative humidities were 70% and 47% respectively.

The parent plants were raised from seeds in pots of 30 cm diameter and 30 cm depth containing sandy clay loamy soil. Throughout the growth period plants were fertilized with 'Thrive' commercial fertilizer (N 31%, P 4.6%, K 9%) every two weeks at the rate of 250 cc per pot. After six weeks of vegetative growth the shoots of the parent plants were cut to a height of 10 cm and the light treatments applied.

Experimental treatments

The layout was a fully randomized block design with four replications.

The different levels of light were obtained by using 'Sarlon' shade cloth, which gave light transmissions of 60% and 30% of full day light in the glass house, while the control plants received 100% of day light. The shade screen was mounted on a frame 120 cm x 90 cm x 130 cm, each screen shading a set of seven pots. Light treatments were imposed on the parent plants for six weeks. The levels of irradiance at plant height were measured using a 'Lambda' quantum meter which recorded the light flux density of photosynthetically active radiation in μEM^{-2} s^{-1} These measurements were taken on clear sunny days and cloudy days and used to calculate the mean irradiance under each treatment. The three light treatments; full daylight 60% and 30% of daylight gave mean values of around 1650, 1050 and 480 μEM^{-2} s^{-1} respectively. After six weeks basal cuttings of 11 cm length with two nodes were taken from the parent plant and planted in wooden boxes (64 cm x 30 cm x 10.5 cm) at three cuttings per row with three rows per box with a spacing of 15 cm x 7 cm. Before planting cuttings 'Thrive' fertilizer was applied as previously. A few basal cuttings were also taken to measure the initial total soluble carbohydrate content (expressed as mg. of Glucose on dry matter basis).

Harvesting was carried out at intervals of two weeks, after planting. At each harvest, three cuttings were separated by a partition in order to provide a uniform growth for the rest of the cuttings throughout the experiment.

Log transformation was suitable for certain parameters. (In the figures, points subtended by the same letter between lines do not differ significantly).

RESULTS AND DISCUSSION

Soluble carbohydrate content

Stem cuttings of parent plants grown under full day light treatments contained significantly higher ($p < 0.01$) amounts of carbohydrates (26%) than the cuttings which received either 60% (17%) or 30% (10%) of full day light.

At full day light, the parent plants may have acquired assimilates more rapidly than that required for cell expansion and multiplication and also for other plant processes. As a result, the surplus carbohydrates would have accumulated in the stem cuttings. In the case of 60% and 30% day light treatments, less carbohydrates would have accumulated due to the fact that under low light conditions less photosynthates would have been produced and the carbohydrate reserves already available in the parent plant may have been partly utilized, accounting for the reduction in corbohydrate reserves. Similar results have been reported by Burns (1972) who showed that low light intensity produced lower carbohydrate content in Bermuda grass (*Cynodon dactylon*).

Top growth

The effects of tiller production, leaf area and the dry weights of tops of the established cuttings, as influenced by the different light environments experienced by the parent plant are illustrated in Figures 1,2 and 3 respectively.

Overall treatment effects showed that cuttings from the full daylight treatment produced significantly higher number of tillers, larger leaf area and higher dry weights of tops than the rest of the treatments ($p < 0.01$).

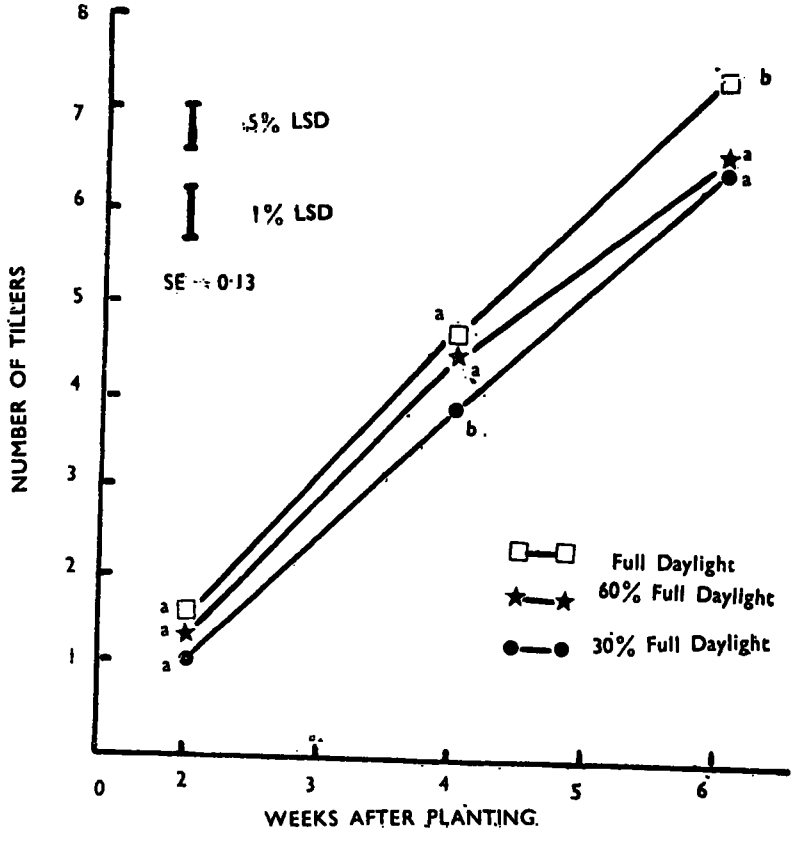

Fig. 1. Tiller number of cuttings as influenced by the three light regimes of the parent plant.

At the first harvest there was no marked difference in the tiller numbers and also in leaf area produced by the cuttings taken from different light regimes. However, at the second harvest the full daylight treatment produced significantly higher number of tillers and a larger leaf area than 30% light treatment ($p < 0.01$).

This may indicate that the soluble carbohydrate in the stem bases may have been utilized to produce more tillers and leaves only at later stages of establishment of cuttings.

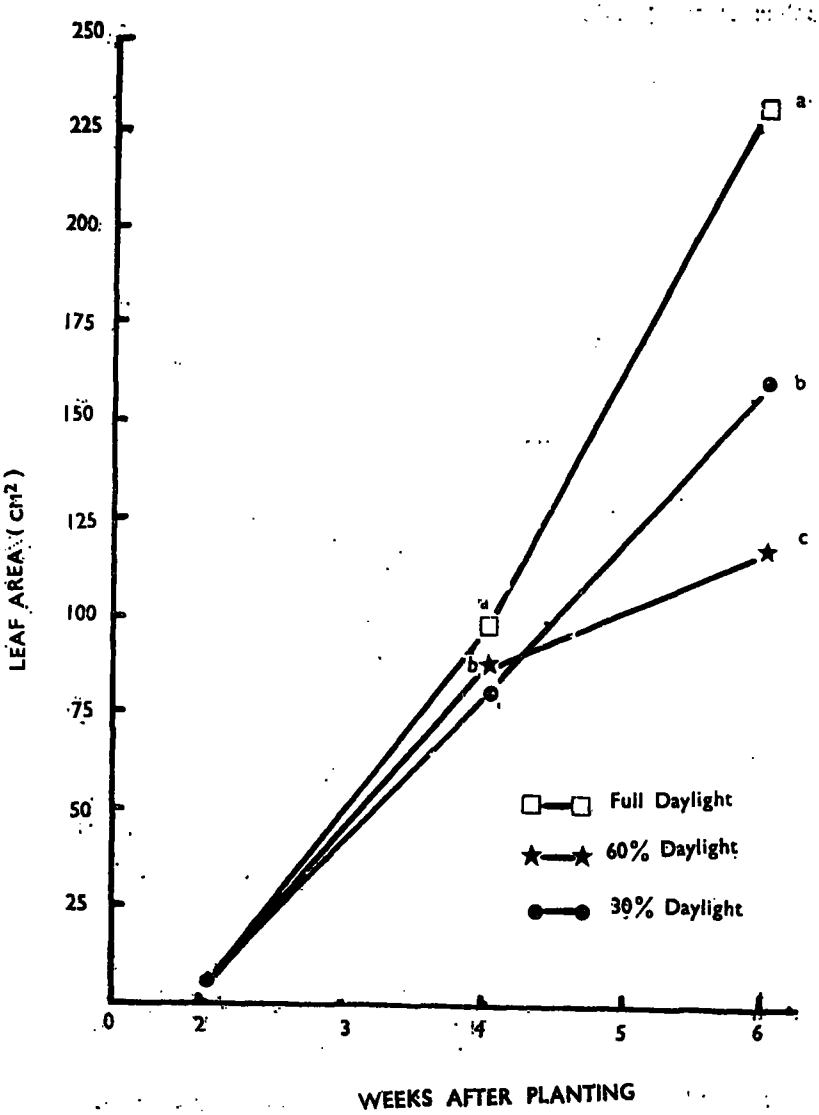

Fig. 2. Leaf area (cm 2) of cuttings as influenced by the three light regimes of the parent plant

Note: Significance is based on Logarithmic transformed data.

No significant differences in tiller number was observed between the cuttings from 60% and 30% daylight treatments, but 60% treatment produced a significantly larger leaf area than 30% treatment at the third harvest.

The significantly higher top dry weight ($p < 0.01$) of cuttings from the full daylight treatment, when compared to the rest of the treatments at all harvests, may be due to the production of more tillers and leaves which may be attributed to the higher soluble carbohydrate content.

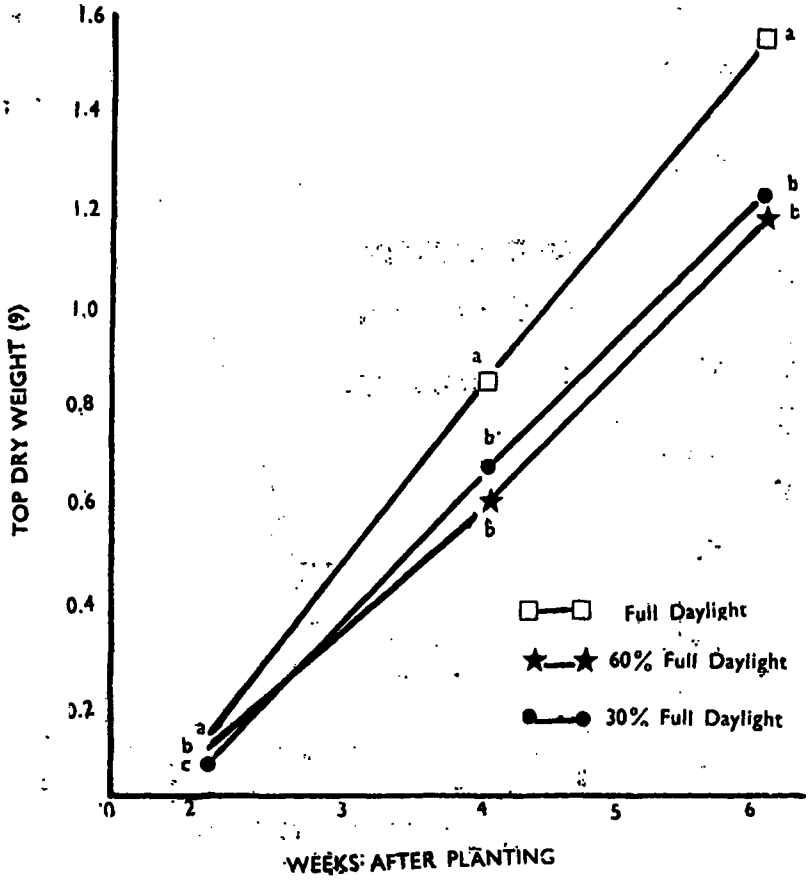

Fig. 3. Top dry weight of cuttings as influenced by the three light regimes of the parent plant.

The significant differences in dry weight of the tops between the 60% and 30% daylight treatments at the first harvest may also be due to the same reason.

Root growth

Overall results demonstrated that effects due to full daylight treatment were highly significant when compared to 60% and 30% daylight treatments ($p < 0.01$). A similar trend was observed at the first harvest, but at second harvest the cuttings from both 100% and 60% day light treatments had significantly higher root dry weights than the 30% treatment.

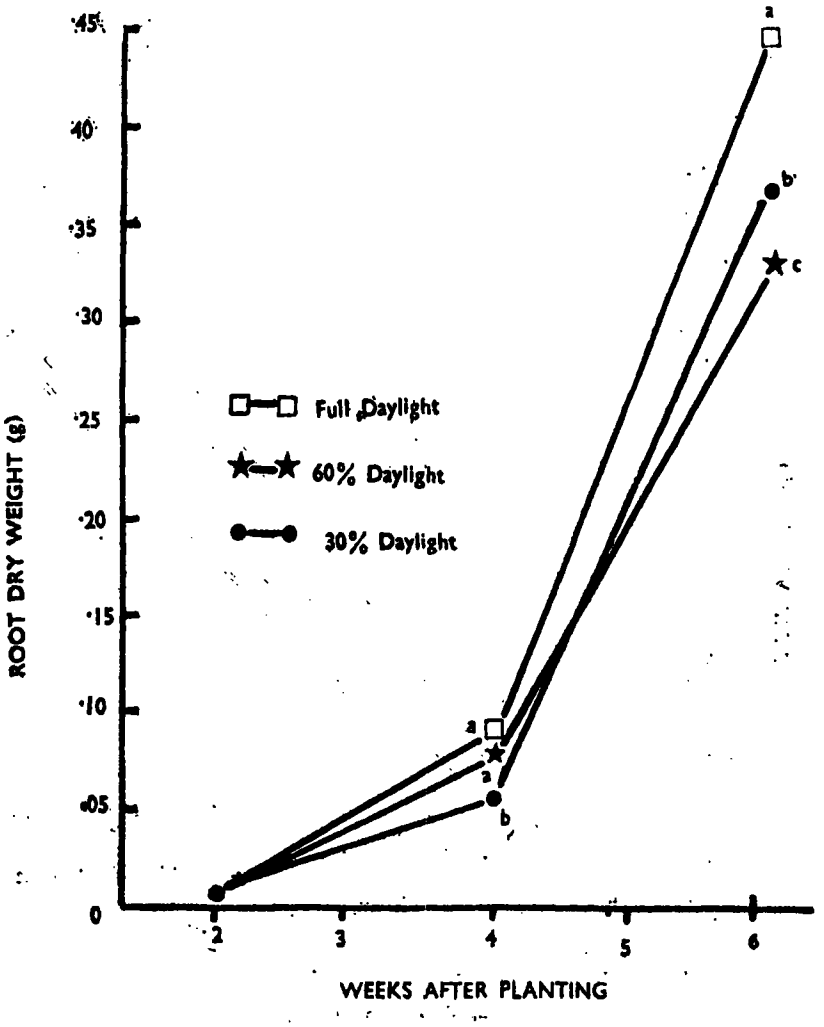

Fig. 4. Root dry weight of cuttings as influence by the three light regimes of the parent plant.

Note: Significance is based on log transformed data.

Root dry weight at the third harvest also appeared to be significantly higher in the full daylight treatment by comparison with the rest of the treatments. The significantly higher dry weight of roots from full day light treatment at all harvest indicated that the stored assimilates would have apparently diverted to the roots during establishment. From these results it may also be deduced that sufficient foliage produced by the cuttings under full daylight and 60% day light treatment would have contributed more assimilates to root production, which seemed to agree with the findings of Ward and Blaser (1961). The low root dry weights of cuttings from the 30% daylight treatment suggest that limited carbohydrate reserves have been utilized for top growth in preference to root growth.

The surplus carbohydrate accumulated in the stem cuttings of full day light treatments as a result of acquiring assimilates more rapidly than is needed for various plant processes may be responsible for the vigorous top and root growth when compared to 60% and 30% daylight treatments. These results suggest that parent plants of *B. decumbens* raised on open land or on young plantations upto about third year or on senile plantation may be more suitable as a

source of planting material than those grown on a mature plantation for commercial cultivation of grasses. Coconut stands with 60% light transmissions may be preferred to coconut stands with 30% light transmission on the ground.

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