ABSTRACT

An understanding of photosynthesis and assimilate partitioning is important for the improvement of productivity of palms, and the paucity of information on these aspects of palm physiology led to the work reported here.

Studies were carried out under glasshouse conditions, to assess the effects of water deficit and nitrogen nutrition on carbon dioxide assimilation and assimilate partitioning in two species of palms, Chrysalidocarpus lutescens H. Wendt and Chamaedorea elegans Mart.

Laboratory studies showed that light saturation of photosynthesis occurred at approximately 600 μmol quanta $m^{-2}s^{-1}$ in C.lutescens, a species occurring naturally in relatively large forest gaps, and at approximately 140 μmol quanta $m^{-2}s^{-1}$ in C. elegans, a species characteristic of more shaded environments. The light compensation points for both species were approximately 25 μmol quanta $m^{-2}s^{-1}$. CO_2 saturation of photosynthesis occurred at a partial pressure of approximately 1200 μbar CO_2 in both C. lutescens and C. elegans, and the CO_2 compensation points were both between 140 and 160 μbar. The photosynthetic responses of these palms to CO_2 are similar to those reported for the economically important palm species, Cocos nucifera and Phoenix dactylifera. In vitro activity of the RuBP carboxylase-oxygenase enzyme, total soluble proteins, chlorophyll content, and chloroplast ultrastructure further

confirmed the shade-adapted photosynthetic characteristics of these two species of palms.

Glasshouse studies on CO_2 assimilation rates of _C. lutescens_ and _C. elegans_ yielded significant correlations between apparent photosynthesis and both leaf water potential and soil nitrogen supply. CO_2 assimilation was affected by short term water deficit due to reduced stomatal conductance and long term water deficit affected RuBP carboxylase enzyme activity as well. Reduced nitrogen supply affected CO_2 assimilation rates through reduced leaf area growth and both stomatal and mesophyll conductances to CO_2.

^{14}C-labelling studies under normal glasshouse conditions revealed that patterns of assimilate partitioning in palms were similar to those in other C_3 species, with less than 50% of the assimilate being exported from a source leaf within the first 6 hours. Longer term studies on the distribution of ^{14}C-labelled assimilate showed a gradual release of assimilate from the source for more than one week. During vegetative growth, developing leaves at the apex functioned as the most active sinks. During reproductive growth, assimilate partitioning depended on the developmental stage, proximity and possibly the orthostichy of the inflorescences with respect to the source leaf. Most of the labelled assimilate that remained in the source leaf was recovered as hexoses, with lesser amounts of sucrose within the leaf laminae. Leaf bases functioned as temporary repositories, storing a substantial quantity of assimilate as starch.

During soil moisture deficit and nitrogen deficiency, shoot growth was reduced whilst the growth of roots increased. Current photosynthate partitioning also followed the same pattern, with more assimilate being partitioned into the roots. Studies on the combined effects of water deficit and nitrogen deficiency indicated that moderate nitrogen supply (application of 5 mmol N l^{-1} to the soil) with adequate soil moisture (soil maintained at field capacity) resulted in maximum photosynthesis and partitioning of assimilate to developing leaves and inflorescences within these two species of palms.