

ABSTRACT

A STUDY OF THE RESPONSES OF COCOA (*Theobroma cacao* L.) TO HIGH IRRADIANCE

ISAAC K. A. GALYUON

The use of cocoa cultivars with improved tolerance to high irradiance may enhance crop establishment and improve yields with reduced need for shade management. The responses of a range of genotypes to 50% and 100% sunlight were investigated using 6-8 month old seedlings and cuttings.

Leaf size and total leaf area (LA) per plant were significantly reduced in full sunlight, while leaf thickness, specific leaf weight (SLW) and stomatal density were increased. In seedlings, leaf number was reduced even though leaf flushing was more frequent in full sunlight. Leaf area ratio (LAR), net assimilation rate (NAR) and relative growth rate (RGR) tended to be lower and plant dry matter was significantly reduced in full sunlight. The partitioning of dry matter to the root was greater in full sunlight especially in cultivar TSH919.

Chlorophyll and carotenoid levels and the chlorophyll/carotenoid ratio were reduced in full sunlight, while net photosynthesis (P_n), transpiration rate and leaf diffusive conductance (g_L) were significantly increased. Shoot dry matter, P_n , and g_L in full sunlight were apparently related to flush size and initial colour. Chlorophyll fluorescence measurements indicated a reduction of the photochemical efficiency of photosystem (PS) II and a decline in the rate of electron transport in full sunlight, but these effects did not seem to have adversely affected P_n . Foliar application of methanol resulted in increased leaf expansion and thickness in full sunlight, but had no significant effect on dry matter production, P_n or chlorophyll fluorescence.

Cultivars TSH919 and TSH1188 had smaller leaves but higher P_n and growth rates than TSH1095 which had broader leaves in 100% sunlight. Paraheliotropism occurred in all genotypes and leaf cupping was observed in cultivar TSH919 and its progenies in full sunlight. Results suggest that leaf size and thickness, initial leaf colour, flush size, paraheliotropy, leaf cupping and P_n may be related to high irradiance tolerance in cocoa.