CANOPY ARCHITECTURE AND LIGHT DISTRIBUTION IN MAIZE

by

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Crop production reflects the efficiency of photosynthetic activity of the plant which is a function of interception of radiant energy for the assimilation of carbon dioxide. The pattern of light penetration and interception is dependent on the architecture of the crop and thus improving the total light interception and distribution within the canopy should lead to increased growth and yield.

Vertical leaf orientation is one way of increasing light penetration into the canopy since spreading foliage decreases the light extinction coefficient and lowers the transmission ratio. An experiment was conducted to determine the effect of leaf angle adjustment on light distribution in the maize canopy and its subsequent effect on yield. Leaf adjustment involved securing leaves in a more upright position with long narrow strips of clear polythene, resulting in changing leaf angles from the normal range of 25°-72° to between 10°-18° from the vertical. Treatments were imposed at 50% silking and consisted of repositioning all leaves on the plant (total adjustment), only leaves above the ear (partial adjustment) and untreated controls. Light measurements were taken periodically within the canopies after treatment, and growth analysis harvests were made at weekly intervals.

The degree of light transmission through the canopy decreased as population density increased (Fig. 1). Adjustment

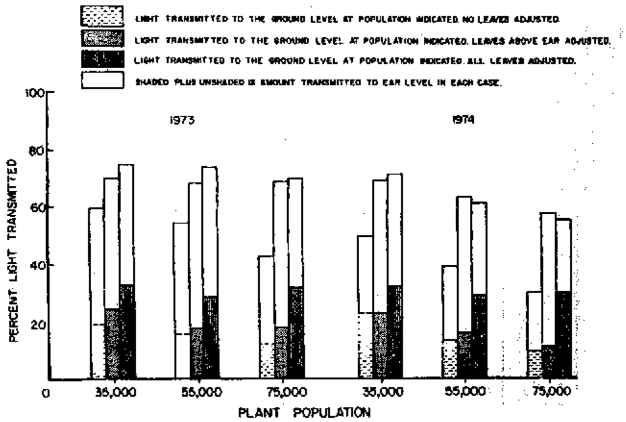

Fig. 1: Effect of leaf angle adjustment on light penetration into maize canopy.

of leaf angle resulted in increased light penetration and with total adjustment the percentage of light transmitted to ground level and not intercepted by the canopy was indicative that plant architecture exemplified by all leaves vertically orientated is not desirable in terms of light utilization.

There was no significant difference in total dry matter produced in the different treatments within the respective population densities since at the time treatments were applied, vegetative growth and dry matter production, other than in the ear, was almost complete. However, there was a significant increase in dry matter accumulated in the ear under different treatment at high population density. This was reflected in a higher crop growth rate for the treated plants particularly those with upper leaves adjusted (Fig. 2). The increase suggests

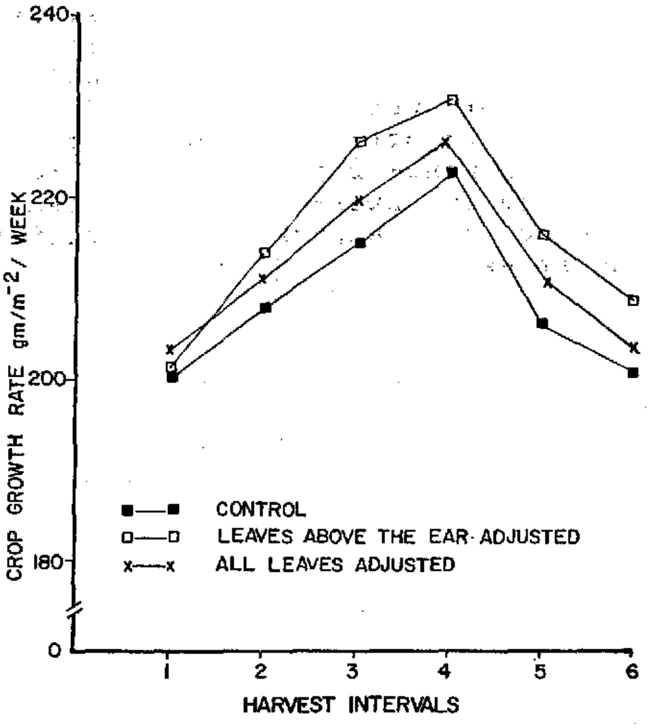

Fig. 2: Effect of Leaf Angle Adjustment on Crop Growth Rate of Maize.

that the middle and to a certain extent the lower leaves, which received greater illumination following leaf angle adjustment, increased their photosynthetic activity and thus contributed additional assimilate available for grain filling. It could also be argued that through upper foliage adjustment, the enhanced illumination on the ear itself may have enhanced sink activity possibly by affecting sink temperature and consequently grain development.

The results presented here show that adjustment of leaf angle to a more upright position decreased the attenuation of light within the canopy although total leaf adjustment reduced the amount of light intercepted. Vertical leaf orientation in the upper atrata at high population densities in the lowland tropical environment seems advantageous to maize productivity.

Questions concerning whether yield was promoted through increasing grain numbers or grain weight were discussed. The roles of factors other than promotion of middle canopy photosynthesis in increasing yield, such as possible enhancement of ear sink-activity, enhancement of activity of leaves feeding the root system, or possibly change in balance or activity of growth regulators were discussed. It was suggested that required plant structure for maximum light interception with maize as mono-crop may be different if the objectives were related to an inter-cropping system. The importance of carrying out such experiments in addition to a modeling approach was stressed.