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Effects of Plant Density and Row Width on Canopy Architecture in Sorghum

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Abstract

Plant architecture can be used to simulate resource acquisition, biomass production and plant stand levels thus enabling for resource capture efficiencies to be compared between architectures which differ for genetic or environmental reasons. Understanding effects of plant density is essential for a wide range of applications from breeding of cultivars adapted to high densities, to understanding the behaviour of associated crops or the competition with weeds.

Five biofuel sorghum genotypes and one maize hybrid were grown at two planting densities (20 plants/m^2 and 30 plants/m^2) and two row distances (40 cm and 67 cm). The elevation angle, phyllotaxy and blade curvature orientation were monitored using 3 D Polhemius digitiser and the shoot organ characteristics (leaf area, leaf length, leaf area index, total biomass) were monitored by destructive measurements. Leaf area indices calculated from destructive measurements were compared with those of nondestructive measurements using the LAI-2000 device (Licor, Lincoln, USA).

Variation of plant density caused significant changes in architectural traits like leaf area index (LAI) and total biomass. From the early stages of crop growth, leaf elevation angle (L5-L7) and azimuthal orientation were markedly affected by treatments, with the measured leaf length showing a strong correlation ($r^2 = 0.84$) to the digitised leaf length. An interaction between width and population density on total biomass of the crops was determined for one genotype (*S. bicolor* × *S. sudanense*) displaying the highest biomass and leaf area index (LAI) under all conditions. This might have been triggered due to the genotype having small and narrow leaves that led to low leaf area which are compensated by tillering and branching. The interactions between genotypic and environmental characteristics affecting plant behaviour were analysed and genotype specific characteristics for traits like tillering, leaf area formation and leaf orientation described.

Keywords: Leaf area index, plant density, plant architecture, sorghum genotypes

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