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Water Use, Yield Formation and Gas Exchange of Cowpeas under Water Deficit at Flowering

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Abstract

A greenhouse experiment with two irrigation treatments [control at 40 to 80 hPa and water deficit (wd) stress at 350 to 400 hPa] were conducted from September 2004 to February 2005 with nine non-nodulated cowpea [*Vigna unguiculata* (L.)] genotypes. At the onset of flowering wd stress was imposed to determine the effect on gas exchange, evapotranspiration efficiency (ETE) and productivity (biomass and yield), the relationship among these characteristics, and to identify possible surrogate traits for ETE and leaf-level transpiration efficiency (TE_i) in relation to yield.

Gas exchange [net assimilation rate (A), transpiration rate (E) and stomatal conductance (g_s)] declined under water deficit (wd) stress. However, TE_i (that is A/E) was enhanced. Extended flowering relative to control ensued from wd. Under wd plants had shorter stems, reduced leaf area, increased specific leaf area (SLA), reduced shoot biomass, but the response of evapotranspiration efficiency (ETE) varied in genotypes. Relative to control wd reduced pod and seed mass in eight out of the nine genotypes. Pod and seed number displayed a corresponding reaction. Single grain mass, shelling out-turn and harvest index (HI) remained constant, declined or increased depending on genotype.

There were correlations among gas exchange parameters under both treatments. Among TE_i, ETE and HI no relationship was detected in both treatments, while there were correlations among g_s, ratio of stem length to stem mass (SMLR), ETE, SLA, biomass, pod and seed yield, and HI. Wd stress tended to reduce or remove those relationships. A wd susceptibility index calculated on the basis of seed yield indicated that UCR 328, Tu 12348 and IFH 27–8 were the least wd susceptible genotypes. Gas exchange had no direct bearing on productivity.

Keywords: Cowpea, evapotranspiration efficiency, harvest index, stem mass to stem length ratio, stomatal conductance, water deficit, water use

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