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DIURNAL PATTERN OF WATER BALANCE IN MATURING COWPEA PODS AND THEIR SUBTENDING LEAVES DURING SOIL MOISTURE STRESS

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Introduction

Soil watcr availability plays a critical role in the water balance of cowpea pod and its subtending leaf. There is evidence that thc fruit of cowpea generates surplus water via phloem import (Peoples et a1 . 1984), a lot of which flows back to the parent plant during hours of high evaporative demand. This may be a factor, among others. which account for the high abscission of fruits during soil moisture stress. This paper reports on water balance factors that may be rcsponsihle for the observed abortion of maturing pods, and thc relationship between leaf soluble sugars and the ability of thc plant to osmotically adjust diurnally during stress.

Methods

Cowpea (*Vigna unguiculata* [L.] Walp.) cultivar Mouride (IS86-275) was planted in the field during the summrr of 1995. Thc experiment was a completely randomized design with each treatment replicated six times. Daily class A pan evaporation was 5.4 to 8.f mm day^{-1}. The plants were thinned down to 40.000 plants ha" Water stress was inducrd during flowering by exclusion of irrigation for stressed plots. Soil water dcpletion was monitored by neutron probe, and gravimetrically. Flowers that opened at thc first fruiting position of the main stem on day 45 after sowing were tagged, and the resulting pods and their subtending leaves were studied. Diurnal measurements of stomatal conductance and transpiration (by porometry), watcr (ψ, by psychrometry), osmotic (ψ_s, by osmometry) and pressure potentials (ψ_p, as ψ-ψ_s), and relative water content (RWC) were taken at different stages after stress. Xylem ψ, ψ_s and ψ_p of branches

and cover growth rates (by sunfleck ceptometry) were measured two times weekly. On day 16 after anthesis samples werc collected for sugar analysis. Soluble sugars were quantified from a standard curve devcloped with an analytical grade glucose.

Results

The results are presented graphically in Figures 1, 2, 3, 4. 5 and 6 as follows:

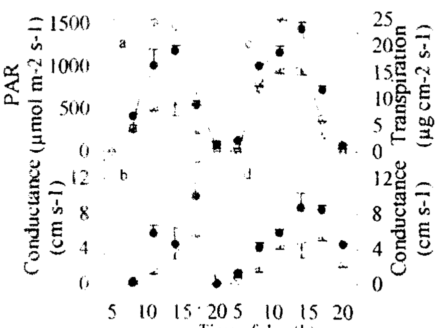

Fig. 1 Diurnal variation in photosynthetically active radiation. PAR ( ), transpiration rate and stomatal conductance of stressed ( ) and

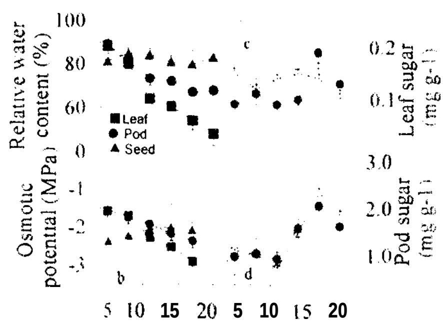

Fig. 2. Diurnal variation in RWC (a) and osmotic potential (b) of rapidly drying plants on day 17 after stress. Sugar content of leaf (

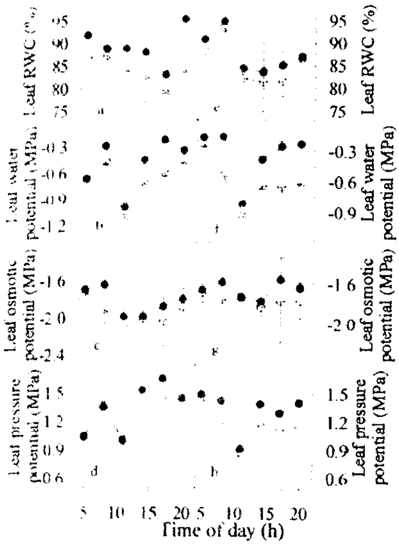

Fig.3. Diurnal variation in leaf RWC, water potential, osmotic potential and pressure potential of stressed ( ) and irrigated (●) plants on day 12 (a, b, c, and d) and day 22 (e, f, g, and h) after stress

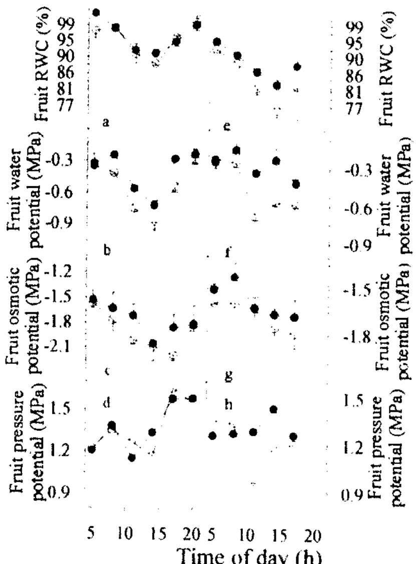

Fig. 4. Diurnal variation in fruit RWC, water potential, osmotic potential and pressure potential of stressed ( ) and irrigated (●) plants on day 12 (a, b, c, and d) and day 22 (e, f, g, and h) after stress.

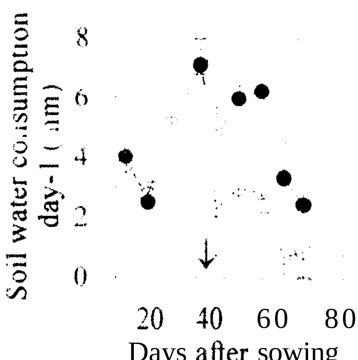

Fig. 5. Daily soil water consumption of ctressed ( ) and irrigated (●) plants during the period. Arrow indicates day soil moisture stress was applied.

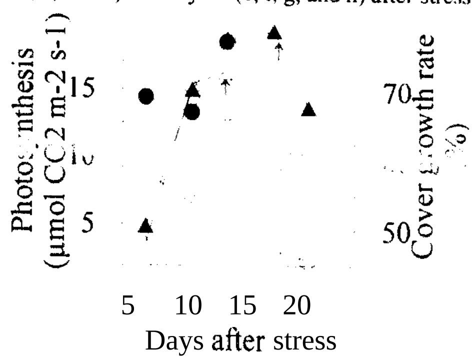

Fig. 6. Cover growth rate in stressed ( ) and irrigated (A) plants. Photosynthesis in stressed ( ) and irrigated (●) cowpea. Arrows indicate beginning of senescence and lose of foliage.

Conclusions

Soil water depletion rates in stressed plants was closely related to their 22.8% abortion of developing pods thus contributing to a lower pod yield of 1.08±0.21 t ha^{-1} compared with a 4.0% abortion and 1.7±0.30 t ha^{-1} yield in irrigated plots. Gas exchange was maximum at periods of high evaporative demand, and it significantly influenced pods and their subtending leaves (and xylem) water status. Most of the water retranslocated to the parent plant during hours of high evaporative demand was from the pod wall, rather than seeds. A relationship existed between ψ_s