PREDAWN LEAF WATER POTENTIAL EQUILIBRIUM IN COMMON BEAN UNDER SOIL WATER DEFICIT


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Introduction. Predawn leaf water potential (Ψlp) has been used to estimate soil water potential (Ψs) based on the assumption that Ψlp equilibrates with the Ψs around the roots (Slatyer, 1967; Donovan et al., 2003). However, the relationship of Ψlp and Ψs is at present controversial. Consequently, the objective of the present study is to determine whether predawn water potential equilibrium is achieved in all parts of the common bean plant, as a consequence of equilibrium with the soil during drying. When this occurs the Ψlp of leaves at different levels on the main stem should be equal or approximately equal.

Material and Methods. Greenhouse-grown potted plants of Phaseolus vulgaris L. type III, cv. Bayo Madero (Acosta, 1982) were subjected to two moisture treatments: irrigated (I) and non-irrigated (NI). In the second treatment, irrigation was suspended when the 3rd compound leaf had just unfolded. At each sampling date, Ψlp of the main stem leaves and their transpiration rate, evapotranspiration (ET), wilting progression were determined, as well as soil water content and atmospheric vapor pressure deficit (VPD).

Results and discussion In all sampling dates Ψlp equilibrium was reached in NI and I (Fig. 1a and 1b). Therefore, it can be assumed that equilibrium was reached in all parts of the plant. In NI, Ψlp reached equilibrium in spite of increasing soil moisture deficit, a certain amount of nocturnal transpiration, stomatal conductance and VPD. From the 6th day (d) after irrigation suspension, the rate of ET during the day and night diminished and reached a minimum at the 9th d (Fig. 1c and 1d). Afterwards water absorption probably stopped or became minimal and the ET value was due mainly to evaporation. Soil field capacity was reached at the 6th d and permanent wilting percentage at the 14th d after irrigation was suspended (Fig. 1e). On the other hand, in the I treatment the soil moisture was maintained at close to field capacity during the entire experiment. Equilibrium between the Ψlp and the Ψs was not reached in any treatment (Fig. 1b).

In the 3rd compound leaf, visual symptoms of the onset of permanent wilting condition were closely related to a Ψlp of -1.5 MPa. Therefore, the value of Ψlp is a good quantitative estimator of the onset of the plant permanent wilting condition.

Literature cited
Figure 1. Predawn water potential of leaves (a), leaves and soil (b), evapotranspiration rates (c and d), and soil water content (e), after irrigation was suspended. FC=soil field capacity, PWP=soil permanent wilting percentage, SL=simple leaf, C1...C4=compound leaf number, I=irrigated, NI=non-irrigated, NS=non-significant and *=significant at $P<0.05$. 