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## Date Palm (*Phoenix dactylifera* L.) Plants under Water Stress: Maximisation of Photosynthetic CO<sub>2</sub> Supply Function and Ecotype- specific Response

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### Abstract

Drought and water stress to plants is a worldwide problem, however, it is more widespread and acute in arid and semi-arid regions where the cultivation of date palms constitute one of the most successful agricultural activity. Adaptation of date palm to water stress is more expected as it is one of the first fruit trees which were distributed and taken into cultivation in naturally dry regions. In this study the morphological and physiological responses as well as photosynthetic gas exchange characteristics were examined in date palm (*Phoenix dactylifera*) plants subjected to water stress under greenhouse conditions. Irrigation treatments include 10, 25, 50 and 100% of field capacity (FC). Plants of soft and dry types of date palm cultivars, under different water levels were exposed to stepwise changes in CO<sub>2</sub> concentration. The Farquhar biochemical model was fitted to the response curves. Values for the photosynthetic parameters the rate of electrons supplied by the electron transport system for ribulose 1,5- biphosphate (RuBP) regeneration (Jmax) and the carboxylation efficiency of the rubisco enzyme (Vmax) as well as their water dependences were derived from the measurements. The results showed that water stress induced multiple changes in plant growth and morphology. Overall reduction in photosynthetic capacity of date palm plants at 50% FC ( $5.25 \pm 0.34$ ) is moderate when compared to 100% FC ( $5.61 \pm 0.38 \mu\text{mol m}^{-2} \text{s}^{-1}$ ). However, the reduction was significant ( $p < 0.001$ ) at 25% and 10% FC, 4.0 and  $2.55 \mu\text{mol m}^{-2} \text{s}^{-1}$  respectively. Higher levels of photosynthesis were observed at 1500 ppm CO<sub>2</sub> in every irrigation treatment. On the other hand, there was significant interaction effect ( $p < 0.001$ ; R Squared = 0.88) between water levels and the elevated CO<sub>2</sub>. Different types of date palm cultivars showed different capacities in growth traits as well as the overall net photosynthesis especially when subjected to water stress. The study also gives highlight to the effects of different treatments on Jmax and Vmax.

**Keywords:** Date palm morphology, *Phoenix dactylifera* L., photosynthesis, Vmax, water stress