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Water Relations and Photosynthetic Rate of an Epiphytic Fern during a Cycle of Drying/rewatering

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Abstract. **Plants of *Asplenium nidus-avis* Hort. were submitted to a cycle of drying/rewatering under controlled conditions. Xylem water potential of the fronds (ψ_p^{xylem}), their stomatal conductance (g), and their net photosynthetic rate (P_n) along the matric potential of the substrate (ψ_m) were measured during this cycle.The relationship between ψ_p^{xylem} and g was an exponential curve. This relationship consisted of 2 phases with a threshold of ψ_p^{xylem} near −0.77 MPa (1 bar = 0.1 MPa). Above this value, there were small changes in g, but below −1.01 MPa, g decreased rapidly. Pn declined below ψ_p^{xylem} −1.01 MPa. Pn and g tended to correlate at low values of g. Initial values of ψ_p^{xylem}, g, and Pn were reattained 48 hr after watering.**

In contrast to the large amount of information available concerning the behavior of photosynthesis and water relations in flowering plants, work on ferns has been limited (4, 9, 13, 16, 18, 19).

Asplenium nidus-avis is a tropical shade epiphytic fern which is commonly localized in/or around rain forests and is a common pot plant. This paper studies some aspects of the physiology of water relations and net assimilation of this fern. Experiments were conducted as a 1st step in relating physiological behavior with subsequent irrigation management in the greenhouse. Experiments were performed on 30 plants of 36-week-old *A. nidus-avis* potted into 9.0 cm diameter × 7.3 cm pots grown in greenhouse. A 3 peat:1 perlite mixture (v/v) was used as a growth medium. Physical properties of this substrate are adequate for epiphytic ferns (10, 14).

Plants were placed in a growth chamber for 1 week before they were submitted to a cycle of drying (15 days)/rewatering (2 days). Light source in the growth chamber was provided by fluorescent tubes (General Electric F-96T12-CW-1500). Photosynthetic photon flux density (PPFD) at the top of the plants was 135 µmol $s^{-1}m^{-2}$, measured with a quantum sensor (LI-COR, LI-190-SB).

Air temperature was maintained at 20° ± 2°C, RH was 70 ± 10%, photoperiod was 12 hr, and CO_2 concentration of the air was 330 ppm.

Plant water status and net photosynthetic rate were monitored during the experiment. Xylem water potential of fully expanded cut fronds randomly taken from 12 plants was measured with a pressure chamber (Soilmoisture 3000) (20). Stomatal conductance was measured on the abaxial surface of nonexcised, fully developed fronds on 6 plants with a LI-COR LI-65 autoporometer.

Net photosynthetic rate was measured in 12 plants in the same chamber growth conditions, using CO_2 depletion techniques (5, 21). Groups of 4 plants were enclosed in 40 liter glass flasks. Glass syringes (1 ml) were used to take 3 air samples in triplicate: 1) immediately after closing the flask, 2) 2 min later, and 3) 5 min later. Immediately, each sample was injected into a SIGMA 4 chromatograph (Perkin Elmer) filled with a katarometer using a Chromosorb 102 column 60/80 mesh, with He as carrier gas for CO_2 analysis.

Frond surfaces were estimated at the end of the experiment with an electronic planimeter (LI-COR, LI-3000).

The change of matric potential of the substrate was monitored on 5 plants. This parameter was measured with microtensiometers (sensing tip ¼" × 1" long, Soilmoisture 2100), and put in the middle of root zone (3 cm depth). Simultaneously, substrate water content was measured gravimetrically and expressed as volume percentage of water.

Stomatal conductance did not change perceptibly until the matric potential fell to -8.8×10^{-3} MPa and decreased below this point (Fig.1). At this stage, water content of the substrate was 29.0% by volume and water availability corresponded to exhaust buffering capacity (6).

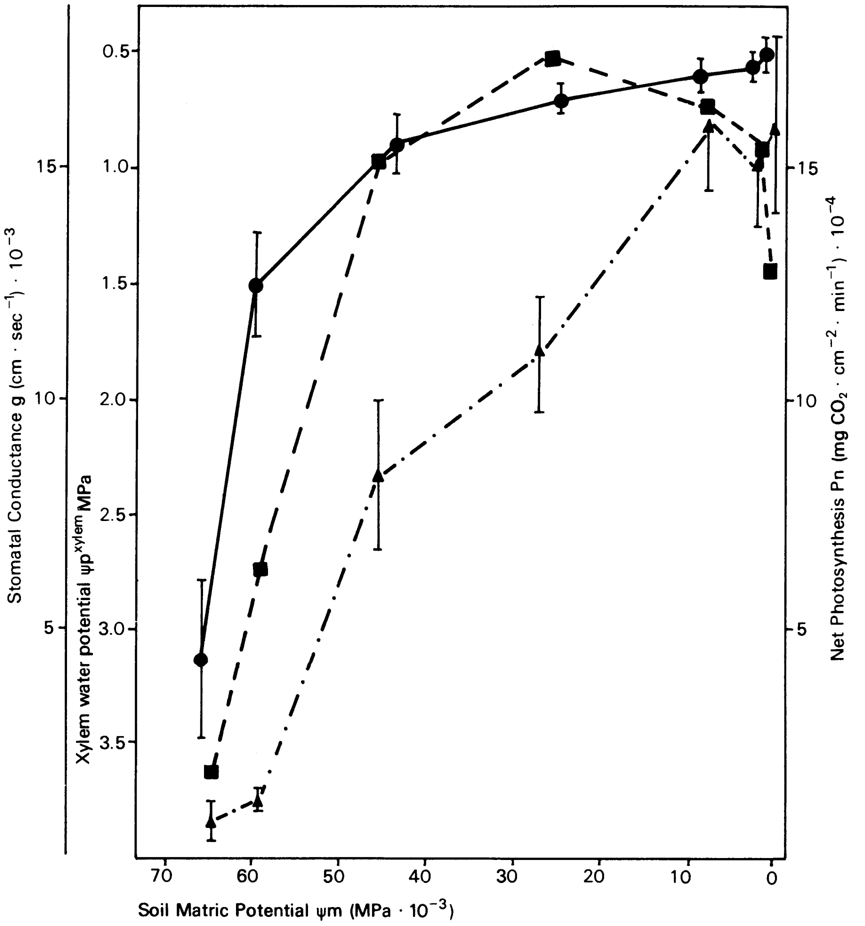

Fig. 1. Effect of desication of substrate on stomatal conductance (g ▲), xylem water potential (ψ_p^{xylem} ●) and net photosynthesis (Pn ■).

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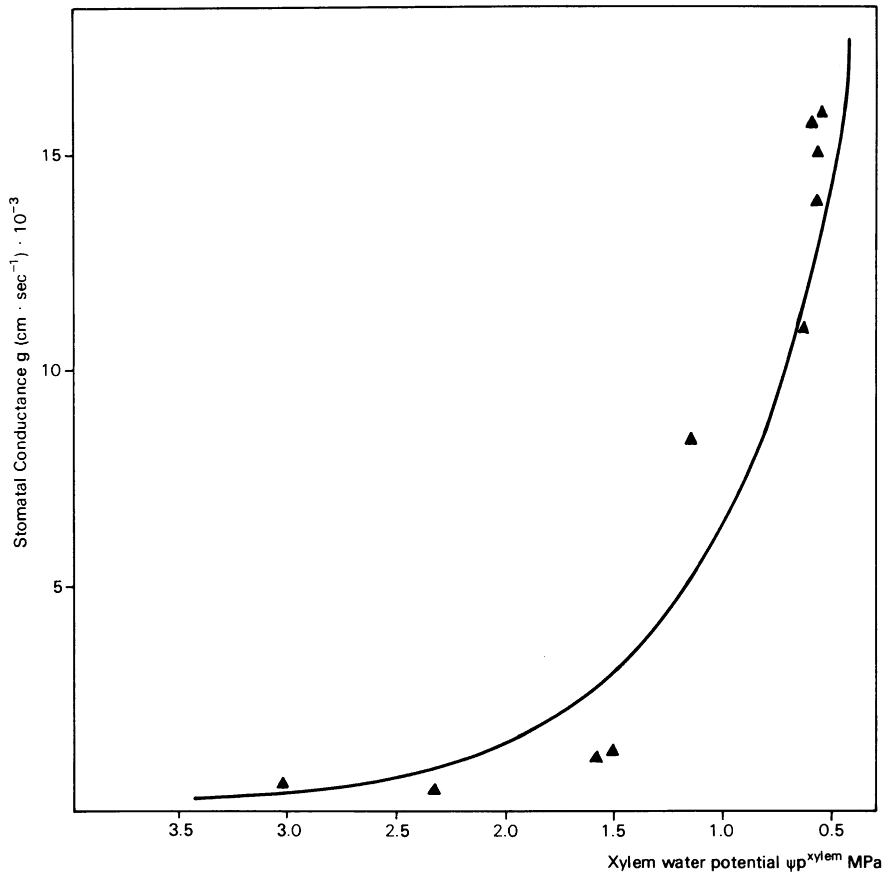

Fig. 2. Relationship between stomatal conductance and xylem water potential during a cycle of drying/rewatering.

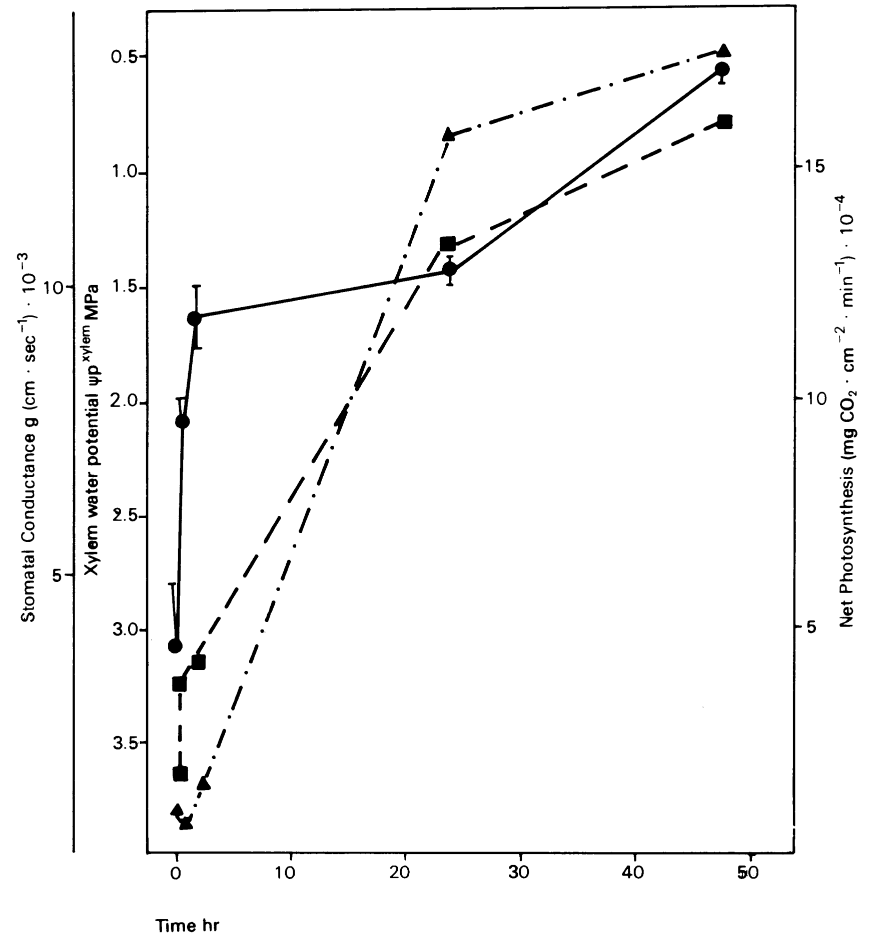

Fig. 3. Effect of watering on the recovering of stomatal conductance (g ▲), xylem water potential (ψ_p^{xylem} ●) and net photosynthesis (Pn ■) a long of time.

Frond xylem water potential remained constant down to values of matric potential of about -45.0×10^{-3} MPa (12.0% volume water). Below this value, frond xylem water potential decreased considerably. At this matric potential, a marked decrease in stomatal conductance was observed, down to a matric potential of -60.0×10^{-3} MPa (6.4% volume water) by which time the stomata were practically closed. The relationship between xylem water potential and stomatal conductance fit an exponential curve (Fig. 2), as reported by Dube et al. (7) ($g = 0.0302\ e^{-0.01555}\psi_p{}^{xylem}$, $R^2 = 0.8436$, $P \leq 0.001$), but, unlike the linear fit proposed by other authors (3, 17).

The relationship consist of 2 phases with a threshold value of frond xylem water potential near -0.77 MPa. Below this value there were small changes in stomatal conductance, but above -1.01 MPa, stomatal conductance decreased rapidly (1, 8, 11, 12, 15).

Our data on recovery after irrigation (Fig. 3) showed that the initial values were reattained after 48 hr, reflecting this ferns adaptability to xeric environments (16, 17). Figure 1 shows that the initial values of the net photosynthetic rate did not decrease until the matric potential fell close to -45.0×10^{-3} MPa. At this point, a strong decrease of the net photosynthetic rate was observed to a matric potential value of -60.0×10^{-3} MPa. The threshold value of frond xylem water potential below which net photosynthesis declined was -1.01 MPa (2, 7). The net photosynthetic rate and the stomatal conductance tended to be proportional only at low values of conductance.

From our data, the Pn maximum was 0.00174 mg $CO_2 \cdot sec^{-1} \cdot cm^{-2}$, this value is double that reported by Hew Choy-Sin and Wong Yik Suan, although there are differences in techniques, plant material, and growth environments. Initial values of the net photosynthetic rate also were reattained 48 hr after watering (Fig. 3).

From our results on water relations and net photosynthesis, we conclude that the pteridophyte *Asplenium nidus-avis* Hort. behaves similar to plants that live in xeric habitats. Consequently, we expect that an accurate irrigation management is not critical.

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BA Induces Lateral Branching of *Peperomia obtusifolia*

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Abstract. **Treatment of *Peperomia obtusifolia* plants with a single foliar spray of N^6-Benzyladenine (BA) at 250, 500, or 1000 mg/liter resulted in compact plants with an increased number of lateral branches.**

Peperomia obtusifolia (L.) A. Dietr. is a popular tropical foliage plant with an upright spreading growth habit and nearly oval leaves that are dark green and glossy. Ease of production and tolerance to low interior light levels are 2 additional reasons *Peperomia* is such an important foliage plant. Plants in production, however, sometimes become leggy and top heavy. Occasionally, the main stem weakens and bends during periods of rapid growth, especially under low production light levels. Such plants normally consist of a single main stem and 1 or 2 lateral branches originating from leaf axils near the soil level. To produce a full and compact plant, commercial growers routinely place 2 stem cuttings with 2–4 expanded leaves per 7.5 cm pot or 3–4 cuttings per 10 cm pot (4). Ability to increase lateral branching of *Peperomia obtusifolia* using growth regulators could eliminate the need for sticking multiple cuttings per pot.

Foliar sprays of N^6-Benzyladenine (BA) have been used previously to induce lateral branching in several foliage plants. Foliar applications of BA at 500, 1000, and 2000 mg/liter significantly increased lateral bud-break of *Dieffenbachia* 'Welkeri' (6). Eight weekly foliar sprays of 100, 250, and 500 mg/liter BA significantly increased the mean number of axillary shoots of *Cordyline terminalis* 'Celestine Queen' (5). Application of a 100 mg/liter BA spray increased phylloclade number up to 150% on *Schlumbergera truncata*, when applied under long day photoperiod (3). BA also has promoted branching of *Hedera helix* (1) and *Dracaena* (2). This paper presents results of an experiment designed to determine if the number of lateral branches of *Peperomia obtusifolia* could be increased by foliar sprays with BA.

Fifty-six plants of *Peperomia obtusifolia* 5–7 cm in height were planted one per 12.5 cm pot in a 2 Florida sedge peat: 1 pine bark: 1 cypress shavings medium by volume containing 4.2 kg dolomite and 5.9 kg Osmocote (19–6–12) per m^3. The 4 treatments consisted of a single foliar BA spray at 0,

Fig. 1. *Peperomia obtusifolia* plants in 12.5 cm pots 12 weeks after a single foliar BA spray. Plants pictured include (from left) untreated control, and BA spray at 250, 500, and 1000 mg/liter, respectively.

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