Effect of waterlogging on photosynthesis and stomatal conductance of chickpea leaves

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Although chickpea is reputed to be intolerant of waterlogging, very few studies concerning the response of chickpea to waterlogging have actually been published. This report describes foliar symptoms of waterlogging, and its effect on photosynthesis and stomatal conductance in chickpea.

Method

Chickpea (cv Tyson) was grown in a black earth under controlled environment zonditions (12h photoperiod, 25/18?C). Waterlogging was imposed at flowering, and control plants were watered to field capacity the same day. Net photosynthesis (P_N) and stomatal conductance (g_s) of the same three leaves per plant were measured daily using a Li-Cor 6200 portable, closed system, infra-red gas analyser. An optical scanner was used to determine leaf area from photocopies of the leaves.

Results and Discussion

Chlorosis was observed after four days of waterlogging, firstly on the upper leaves. Reddish-brown anthocyanin pigmentation developed on midribs, stems and some leaflets. Leaflets folded upward, a symptom typical of moisture stress. Unexpanded leaves had necrotic margins. Abscission of chlorotic leaflets began six days after waterlogging and progressed until most of the plant was defoliated.

In the first 24h, gs of waterlogged and control plants declined, though gs of waterlogged plants fell further, approaching zero after three days (Fig. 1). One day after waterlogging was imposed, PN and gs of waterlogged plants were 87 and 36%, respectively, of the control plants. The rapid decline in gs over 24h, followed by a sharp decrease in PN between days two and four, suggest that waterlogging decreased PN through stomatal closure. A similar pattern of decline in gs and PN was observed in Vaccinium ashei (1). Stomatal closure may have been caused by a decrease in potassium uptake, or production of abscisic acid or ethylene by the plant (2). The reduction in PN may have resulted from effects of waterlogging on carboxylation enzymes and the loss of chlorophyll (2), in addition to the effect of stomatal closure. Further studies are being conducted to develop a screening test for selection of chickpea lines which are more tolerant of waterlogging.

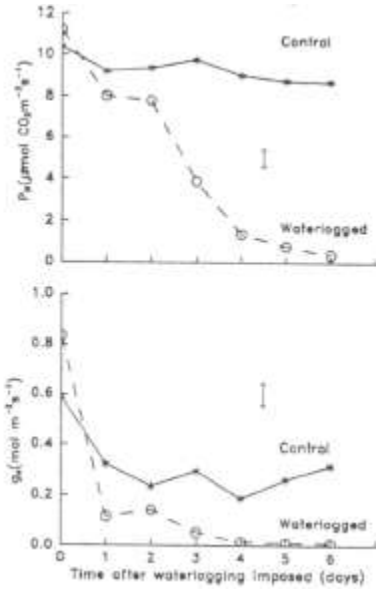

Fig. 1. Effect of waterlogging on P_N and g_s. Error bars are interaction LSD .05 for comparing treatment means within days.

1. Davies, F. S. and Flore, J. A. (1986), P1. Physiol. 81, 289-292.

2. Kozlowski, T. T. and Pallardy, S. G. (1984), Flooding and Plant Growth (ed. T. T. Kozlowski) Academic Press pp165-193