STOMATAL CONDUCTANCE IN RELATION TO XYLEM ABSCISIC ACID CONCENTRATIONS IN *HOPEA ODORATA* AND *MIMOSOPS ELENGI* SEEDLINGS

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Introduction

Stomata impose a critical control over water loss and exchange of gases between the atmosphere and leaf cells. Effective control is important for plant growth and survival especially when water supply is limited. Accumulated evidence has shown that inhibition of leaf growth and stomatal conductance are perhaps the first responses when root systems are exposed to stress conditions, such as drought, flooding and soil compaction. Under these conditions, roots may responds by synthesising and exporting chemical signals through the transpiration stream to shoots where physiological processes are regulated. Much evidence has indicated that root-derived abscisic acid (ABA) in the xylem is involved as the chemical signal in the communication between root and shoot and in the regulation of leaf growth and stomatal conductance, especially under conditions of soil drought and compaction. Although the effects of soil compaction have extensively studied, few experiments have examined involvement of root-to-shoot signalling in mediating plant responses. Increased xylem sap ABA concentrations and associated reductions in stomatal conductance have been recorded in the shoots of maize plants growing in compacted soil under field conditions. It is therefore possible that a root-sourced signal such as ABA may be involved in plant responses to soil compaction. This experiment was designed to examine the relations between stomatal conductance, xylem sap ABA and leaf water potential in two species grown in compacted and unwatered soil, and to investigate whether ABA plays a similar role under these two different stresses in its regulation of stomatal conductance of these two species.

Materials and Methods

Hopea odorata and *Mimosops elengi seedlings* were grown with their roots subjected to soil drying and soil compaction treatments. Twelve measurement were carried out, and stomatal conductance was expressed as a percentage of the control (well-watered and non-compacted). Xylem sap was collected between 1400 and 1600h from detopped plants. Collection pressures varied from 0.5Mpa (for well-watered plants) to 1.5Mpa (for unwatered plants). Leaf samples for ABA analysis were also collected after measurement of stomatal conductance and water potential. Leaves were harvested and plunged into liquid nitrogen. After being freeze dried, samples were stored in a dessicator until assay. The concentration of ABA was measured by a modification of that of Loveys and During (1984).

Results and Discussion

With soil drying, significant reduction of stomatal conductance occurred much earlier than the reduction of leaf water potential. Furthermore, the soil compaction treatment, which had little influence on leaf water potential, also reduced stomatal conductance. These results suggest that, at least at the initial state of both treatments, stomatal conductance was controlled by factor(s), other than leaf water potential. A good relationship existed between stomatal conductance and xylem ABA concentration in both species .The relationship between bulk leaf ABA concentration and stomatal conductance was relatively weak. In compacted soil, stomatal conductance was significant but in compacted, well watered soil, the leaf water potential and bulk leaf ABA concentration were almost unchanged. In the latter treatment, the ABA concentration in the xylem sap increased about three-to five-fold and stomatal conductance was significantly inhibited. Therefore, as in the case of soil drying, xylem ABA could act as a positive stress signal to control the shoot physiology when plants are grown in compacted soil. However, it is still not clear what induced the increase in ABA in xylem sap of plants growing in compacted soil. The ABA increase was probably a result of root dehydration or nutrient deficiency due to limited water and nutrient supply to the roots in compacted soil. The significant increase in ABA in the xylem of plants in compacted soil was a result of leaf water deficit and a loss of leaf turgor. It is therefore arguable that small changes in leaf water potential, possibly not detectable with current equipment, may bring about changes in leaf conductance, which, as a feedback response, may relieve or relax a possible leaf water deficit.

Conclusions

Stomata conductance is very much controlled by ABA concentration in the xylem. The lack of a good relationship between stomatal conductance and bulk leaf ABA concentration may suggest that there is a fairly quick turnover of ABA arriving in the leaves. Stomata respond to the ABA concentration in the xylem, rather than to the total amount of ABA that is delivered. Sensitive regulation by a chemical signal such as this requires that: (a) the concentration in the xylem is a good indicator of water status, rather than a function of xylem water flux; (b) stomata can respond to the changes of signal concentration; and (c) there is a rapid removal of the signal once it has arrived.

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