Kinetin Reversal of NaCl Effects

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ABSTRACT

Leaf discs of Nicotiana rustica L. were floated on NaCl in the presence of kinetin or abscisic acid. On the 5th day 14CO2 fixation, [3H]leucine incorporation, stomatal conductance, and chlorophyll content were determined. Kinetin either partially or completely reversed the inhibitory effects of NaCl while ABA had no effect.

The endogenous levels of cytokinins (CK) and abscisic acid (ABA) are altered in response to water stress whether imposed by drought, salinity, or high transpirational demand. It is possible that these changes play a regulatory role and are an essential part of the metabolic and developmental processes involved in the adaptation of plants to water stress (5). Attempts to prove this by reversal of the stress responses with kinetin application have so far failed (8–10). This failure is probably the result of the decrease in stomatal resistance due to kinetin application thereby further enhancing the stress. When kinetin was applied to tissue excised from stressed plants, it reversed stress effects by retarding Chl degradation (5) and enhancing protein synthesis (3, 7). Further, ABA treatment of stressed plants reduced RNAase activity enhanced by water stress (1). It is not clear if this is a direct metabolic effect of ABA or rather a result of a shift in water balance of the plants due to stomatal closure and/or reduction in root resistance. The outcome of experiments in which hormonal balance is manipulated could support the hypothesis that the endogenous changes are regulating the metabolic response directly during water stress. In this work, such an attempt was made by treating excised tobacco leaf discs floating on NaCl solution with either kinetin or ABA.

MATERIALS AND METHODS

Leaf discs, 15 mm in diameter, from fully expanded leaves of tobacco (Nicotiana rustica L.) were floated on a 0.1% NaCl (w/v) solution for 5 days. Control discs were incubated in water. Kinetin or ABA was added to make 1 µg/ml solutions. On the 5th day, the discs were recut to 12-mm diameter. Four separate evaluations of treatment effects were made: (a) Chl content leaf discs were placed one each in 4 ml of dimethylformamide in the dark. After 2 days at 4 C the optical density of the solution was determined at 665 nm. (b) [3H]Leucine incorporation into proteins, and (c) 14CO2 fixation in light were evaluated as described previously (2, 3); and (d) stomatal conductance was determined with a viscos flow porometer (designed and constructed by D. Shimshi).

RESULTS AND DISCUSSION

The results are given in Table 1 and indicate that the response of discs floating on NaCl solution is similar to the known response of leaves from water-stressed plants (4). Kinetin applied simultaneously with NaCl to those discs altered the stress response. The four processes studied were differentially affected by salinity and the extent of the kinetin reversal was also different. ABA application, on the other hand, manifested the stress conditions. This is in accordance with the assigned role of ABA in the adaptation process to environmental stress. Comparing the changes in 14CO2 fixation and stomatal conductance reveals that the latter cannot account by itself for the increased capacity of kinetin-treated, stressed leaf discs, to fix 14CO2. In this preliminary experiment, no attempt was made to optimize the kinetin concentration, an approach which might result in additional relevant information. The enhancement of three processes by kinetin in the absence of stress condition point toward a possibility that the effect of kinetin on stressed leaf discs is not specific for the stress situation. Careful comparison will reveal, however, that stressed tissue responded to kinetin more than did unstressed tissue. This together with the reported reduction in cytokinins during stress (6) point toward the possibility that kinetin indeed is a limiting factor under stress conditions and plays a role in plant responses to them. Similarly, it can be argued that the effect of ABA treatment to stressed tissue is negligible due to the rise of the endogenous level of ABA, hence no reversal of the response to water stress due to ABA treatment is evident.

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CORRECTIONS

Evensen, Kathleen B., and J. Brent Loy. Effects of Gibberellic Acid and Gold Light on Germination, Enzyme Activities, and Amino Acid Pool Size in a Dwarf Strain of Watermelon.
Page 7, Figure 1 legend, and page 8, Figures 2 and 3 legends should be corrected to include: (▲—▲), H₂O dark; (●—●), H₂O light; (Δ—Δ), GA dark; (○—○), GA light.

Hanson, John B. Application of the Chemiosmotic Hypothesis to Ion Transport Across the Root.
Page 404, column 1, equation 4, element 3 should be corrected to read: \( \frac{Z\Delta pH - \Delta \psi}{R_s^2} \)

Outlaw, William H., Jr., and Jill Kennedy. Enzymic and Substrate Basis for the Anaplerotic Step in Guard Cells.
Page 648, column 2, paragraph 3, last line should be corrected to read: prevented with 1 mM DTT.
Page 652, column 1, reference 7, title should be corrected to read: Enzymic assay of 10⁻⁷ to 10⁻¹⁴ moles of sucrose in plant tissues.

Wiest, Steven C., and Peter L. Steponkus. Freeze-Thaw Injury to Isolated Spinach Protoplasts and Its Simulation at Above Freezing Temperatures.
Page 702, column 2, Figure legend, 4 lines 5 and 6 should be corrected to read: 0.803 osmolal (▲), 1.071 osmolal (●), 1.338 osmolal (★), and 1.607 osmolal (●).

Page 836, line 3 should be corrected to read: Received for publication November 28, 1976 and in revised form May 1, 1978