STUDIES ON CELL

ELONGATION

by

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A THESIS

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The main aspects of the problem of cell elongation that were approached in this investigation included the response of Avena coleoptile sections to supraoptimal concentrations of auxin and the relationship between cell expansion and water uptake. Also, the possibility was explored of employing the effects of ethylene on plants in the further study of the mechanism of cell expansion.

By following the growth-time course of elongation it was found that the initial elongation rate of the Avena coleoptile sections increased with increasing concentration of auxin. The period of active elongation decreased with increasing concentration and was followed by shrinkage of the tissue. In view of the results it was suggested that initial elongation rates cannot be estimated after a single measurement at twelve, or more, hours of growth as practised by certain investigators in applying the methods of classical enzyme kinetics to the analysis of auxin-induced growth. It was also pointed out that some of the assumptions made by the same investigators were not supported by the data collected in this project.

The results indicated that the diminishing total increase in length with increasing concentration of auxin cannot be explained in terms of a steric hindrance of the two-point attachment between auxin and a receptor entity in the plant. If this were the case then the initial period of rapid elongation and subsequent shrinkage would not materialize; a disorganization of the protoplasmic structure by supraoptimal auxin concentrations was indicated.

The crucial relationship between expansion in cell wall
surface and the uptake of water was investigated by using the effects of higher concentrations of auxin and by controlling water movement into the sections by osmotically active solutions of sucrose and mannitol. This part of the project was undertaken in view of the present controversy on the role played by an "active" uptake of water, i.e., uptake against a diffusion gradient, in the process of cell expansion. The results did not support the suggestion that the main effect of auxin is the inducement of water uptake with the wall expanding as a result of the increased hydrostatic pressure of the cell. The data obtained can better be explained by applying the concept of active wall building through a metabolically controlled synthesis of the cellulose framework; in this scheme water entry is visualized as a movement along a gradient produced by increase in the diffusion pressure deficit of the cell as a result of expansion in wall area.

Preliminary experiments were carried out with ethylene in an attempt to define some of the conditions under which this biologically active gas could be used in the exploration of certain aspects of the process of cell expansion. Promising results were obtained in the investigation of factors affecting transverse expansion and promotion of longitudinal extension by ethylene pretreatment of intact Avena seedlings and coleoptile sections.