The Ultrastructure of Wheat Leaves

II. The Effects of Kinetin and ABA on Detached Leaves Incubated in the Light

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Summary

Incubation of detached wheat leaves in water in the light results in a temporary accumulation of starch in the chloroplasts. This accumulation is prevented by treatment with ABA. On the other hand, treatment of the detached leaves with kinetin causes a large increase in the size and number of starch grains.

1. Introduction

The aims of this investigation were to examine the ultrastructural changes which occur when detached wheat leaves are incubated under a 16 hours photoperiod, and also to examine the ultrastructural effects of kinetin and abscisic acid (ABA) when supplied to detached wheat leaves via the transpiration stream. Prolonged illumination of intact plants of Stellararia media has been shown to result in a temporary accumulation of starch grains in the chloroplasts (HAAPALA 1969). SCHOOLAR and EDELMAN (1970) reported that the starch content increased when sugar cane leaf discs were floated on water under continuous illumination, but no electron micrographs were published. A preliminary account of this study has been presented elsewhere (MITTELHEUSER and VAN STEVENINCK, in press).

2. Materials and Methods

2.1. Growth and Incubation Conditions

Wheat (Triticum aestivum cv. Mendos) plants were grown and primary leaves treated with $3.8 \times 10^{-6}$ M ABA, $5 \times 10^{-5}$ M kinetin or deionized water as previously described (MITTEL-
HEUSER and VAN STEVENINCK 1971 a) except that the detached leaves were incubated under a 16 hours photoperiod (850 l/ft², 26 ± 2° C day, 18 ± 2° C night). The vials and solutions were protected from light and were changed daily.

2.2. Electron Microscopy
Leaf segments were prepared for electron microscopy as previously described (MITTELHEUSER and VAN STEVENINCK 1971 a).

3. Results

3.1. Detached Water Treated Leaves
On detachment at 10 days, the mesophyll cells of primary wheat leaves typically appear as in Fig. 1. When leaves are incubated in water under a 16 hours photoperiod, the major change to occur is an accumulation of starch grains in the chloroplasts. Although this is apparent to some extent after 24 hours, it reaches a maximum by 48 hours and thereafter declines (Figs. 2 and 3). Little other change in cell ultrastructure can be detected during the 3 day incubation period. Lipid bodies typical of those observed in senescing wheat leaf tissue (MITTELHEUSER and VAN STEVENINCK 1971 a) are present in the cytoplasm by 48 hours but no change in either the chloroplast or the cytoplasmic ribosome populations can be detected (Fig. 4).

3.2. Detached Kinetin Treated Leaves
Kinetin induces a large accumulation of starch in the chloroplasts of detached leaves incubated under a 16 hours photoperiod. Starch development is apparent after only 24 hours (Figs. 5 and 6) and continues throughout the 3 day incubation period (Figs. 7 and 8). The only other ultrastructural alteration observed in kinetin treated leaves is the presence of deposits in the vacuoles at 3 days (Fig. 7). The nature of these deposits is unknown, but they resemble the protein bodies observed in tomato leaf cells by SHUMWAY et al. (1970). Cytochemical tests were not carried out.

3.3. Detached ABA Treated Leaves
Treatment of the detached leaves with ABA prevents the temporary accumulation of starch grains seen in the water-treated control leaves. Instead, there is a gradual loss of starch from the chloroplasts (Figs. 9 and 10). Considerable development of cytoplasmic lipid bodies occurs during the period of

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Fig. 1. Mesophyll cell of a primary wheat leaf (10 days) showing nucleus, vacuoles, and chloroplasts with starch grains. ×4,000
Fig. 2. Cells from the base of a water treated wheat leaf after incubation under a 16 hours photoperiod for 2 days showing development of starch grains. ×4,000