Changes in Cytoplasmic Particulates Accompanying Growth in the Mesocotyl of Zea Mays

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IT HAS been found that as the cells of corn roots elongate and mature the cytoplasm undergoes several changes (7). There is a decrease in the relative number of microsomal (ribonucleoprotein) granules per unit of cytoplasmic protein and an increase in membranous material and mitochondria. The oxidative activity of the mitochondria is greatest in the region of cell expansion. These cytoplasmic changes in corn root cells are correlated with changes in such physiological activities as tissue respiration (7) and ion accumulation (4).

In order to ascertain whether the pattern of cytoplasmic ontogeny shown by the root cell is to be found in other growing tissues, a similar investigation has been made with the mesocotyl of corn seedlings. This organ is a true internode which grows by means of cell division and elongation in the region just below the coleoptilar node (1). Hence, as in the root, successive sections beginning at the node provide tissue of progressively greater mean cell maturity.

MATERIALS AND METHODS

Except as noted below, the procedures for growing corn seedlings, isolating and analyzing cell particulates, determining respiration rates, and measuring oxidative phosphorylation were those described previously (7). Four successive 0.5-cm. sections were excised from the mesocotyl of 3- to 4-day-old seedlings, beginning just below the coleoptilar node. In the tables which follow, these sections are serially labeled 1 through 4, section 1 being that just below the node. The number of cells in each section was estimated from cell counts on each of five fixed, stained, and mounted cross sections and longisections. The values for cell number per section are the products of the mean number of cells in cross section, including the vascular cylinder, and the mean number of cortical cell lengths per 0.5-cm. longisection. The number of cells in cross section is constant in any one mesocotyl, and growth of the tissue is almost entirely in length (3).

For the isolation of cytoplasmic fractions, pooled sections from 300 to 400 seedlings were counted, weighed and homogenized in 0.5M sucrose for 3 minutes in an ice-jacketed glass homogenizer with a power-driven Teflon pestle. The homogenate was cleared of debris and nuclei at 800 g for 5 minutes, and aliquots of the supernatant were acid precipitated and analyzed for total protein, lipide phosphate, and RNA, as previously described (7) except that the nucleic acid was extracted from the defatted precipitate by the hot perchloric acid method of Ogur and Rosen for DNA (8). No DNA could be detected in the extract by the diphenylamine (10) or cysteine (11) tests for deoxyribose, and the nucleic acid is reported as RNA. Additional aliquots of the homogenate were centrifuged first at 20,000 g for 15 minutes, for the separation of a mitochondrial fraction, and then at 100,000 g for 60 minutes to isolate the microsomes. Analyses for protein, lipide phosphate, and RNA were carried out on the unwashed pellets of these fractions. Electronmicrographs of the cytoplasm of mesocotyl cells of varying maturity were prepared by the techniques used previously (7), except that the embedding was done in Vestopal (9).

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Abbreviations used: RNA—ribonucleic acid; EDTA—ethylene diamine-tetraacetic acid; DNA—desoxyribonucleic acid.