

# ULTRASTRUCTURAL AND RADIOAUTOGRAPHIC STUDIES OF THE DEVELOPMENTAL SEQUENCE, AND OF SECRETORY MODIFICATIONS PRODUCED BY STIMULATION OF THE DIGESTIVE GLAND CELLS OF *DROSERA CAPENSIS* L. WITH REFERENCE TO THE GOLGI APPARATUS

by Robert Lynn Outenreath, Ph.D.  
The University of Texas at Austin, 1980

Supervising Professor: W.G. Whaley

The modern definition of secretion, which among other things includes cell surface modification, is a concept which has been extensively studied in animal systems. Recognition of similar processes which may be at work in higher plant cells is, however, on a comparatively primitive level. For this reason, a study was undertaken of the digestive gland cells of *Drosera capensis* with the view of determining the role of the Golgi apparatus in the secretory process, and to use the data obtained in order to make comparisons with other secretory systems, both plant and animal.

The digestive glands are remarkably complex structures which are capable of a variety of responses. For this investigation two secretory phenomena were studied. The first involved changes taking place during maturation of the glands from a non-secreting state to fully mature glands having a full complement of trapping mucilage. Such studies were possible due to the discontinuous nature of gland population maturation, which permits selection of glands in different stages of maturity from the same leaf. Of special interest were the changes which take place when mature glands are stimulated to secrete additional mucilage after contact with living insects. These studies were carried out using electron microscopic and radioautographic techniques, using  $H^3$ -galactose as the radiosugar.

Morphologically, young, non-secreting glands exhibit inactive Golgi apparatus, which have few stacks of parallel cis-

ternae. As the glands mature and commence mucilage secretion, certain digestive gland cells are often seen to be almost filled with cytoplasmic vesicles which are Golgi-associated. Even when such vesicles are not observed, the Golgi apparatus exhibit numerous cisternae which may be irregularly stacked or curled. When the full complement of mucilage has been exteriorized in mature glands, numerous vesicles are no longer seen, but the Golgi exhibit characteristics distinctive for this stage of development. In addition, certain cell wall characteristics were correlated with developmental stage. Radioautography revealed incorporation in young glands to occur primarily over the still immature central tracheary element. In mature glands, however, extensive labeling was observed over the outer periclinal cell walls. The long label times necessary to achieve sufficient incorporation did not make possible determination of other sites of organelle label accumulation, however, morphological evidence indicated the Golgi apparatus to be the major source of mucilage.

The most striking aspect of this study was the finding of the selective activation of the Golgi apparatus only in certain gland cells. When insects such as *Drosophila* are placed on the glands, a marked increase in the amount of mucilage exteriorized occurs. This is characterized by very active Golgi apparatus in these glands, reminiscent of the beginning of developmental secretion.

Please see **GOLGI** p. 93.

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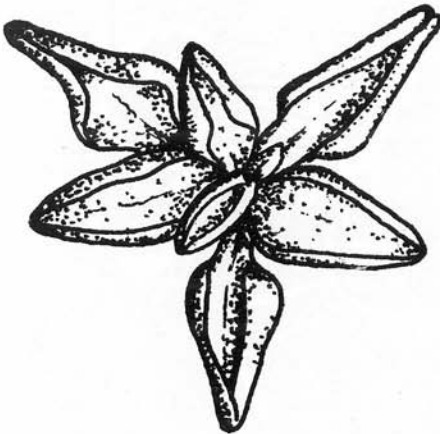
In both cases, active Golgi were found to be located only in those gland cells located at the outer apical areas of the glands. Radioautography revealed intense labeling over the Golgi apparatus, with little incorporation occurring elsewhere. Additionally, the time necessary to achieve good label incorporation was drastically reduced in labeled glands, indicating a marked increase in radio-precursor utilization.

This investigation has resulted in a body of data which firmly establishes morphological criteria characteristic of the various developmental stages. In addition, several new techniques were developed to facilitate study of these glands. The finding of the selective activation of the Golgi apparatus only in the outer apical digestive gland cells is most significant, and indicates a degree of specialization in this species not usually found in higher plants. These, and other findings, are discussed in the context of the universality of the secretory process which may be operative in all eukaryotic cells.

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*Pinguicula pumila*  
Drawing by Ron Fleming