Ultrastructural changes of cells in leaf abscission zone of tomato plant

M. Tušek Žnidarič, A. Kladnik, M. Pompe Novak, and M. Dermastia

National Institute of Biology, Vecna pot 111, 1000 Ljubljana, Slovenia

magda.tusek.znidaric@nib.si
Keywords: abscission, tomato, transmission electron microscopy

Abscission is an active process and has a variety of roles during plant development. Plant parts such as pollen, fruits, seeds, and leaflets may be shed in response to developmental cues through a complex and high regulated metabolic process. Ethylene is known to be a primary regulator due to accelerate abscission and also RNA and protein synthesis [1,2]. Abscission zone may be recognized as a several layers of small, closely packed and highly protoplasmic cells between plant body and subtending organ [3]. In the time of abscission some changes in hormones levels and modifications of elemental compositions of the cells in the plant body side are observed [1,4]. Separation of abscission zone cells involves dissolution of the middle lamella in association with secretion of cell wall hydrolytic enzymes [4].

Tomato plants (*Lycopersicon esculentum* L.) were grown in growth chamber; abscissions were induced with deblading and accelerated with exposure to ethylene for 24 hours. After 4, 24 and 48 hours samples were prepared for light (LM) and transmission electron microscopy (TEM). Intact plant was used as a control. For TEM, approximately 2 mm square blocks of tissue containing the abscission zone were fixed in 3% (w/v) glutaraldehyde, postfixed in 1% (w/v) osmium tetroxide for 12 hours and embedded in Agar 100 resin. Samples were observed with a Philips (Amsterdam, the Netherlands) CM 100 transmission electron microscope at 80 kV.

Ultrastructural modification of the cells in abscission zone (Fig. 1) revealed changes in time dependent manner and were characterized with differences between subtending organ and plant body. Electron micrographs of abscission zone cells indicated that cell separation resulted from dissolution of the middle lamella which led to forming an intercellular space and separation of adjacent cells, while cell walls were still intact (Fig. 2). Breakdown of middle lamella was accompanied by disintegration of cell structure with disruption of tonoplast in leaflet part (Fig. 3). In the part of plant body ultrastructural changes in 2-3 cell lines began soon (even 4 hours) after exposure to ethylene and were clearly recognized after 24 and even more after 48 hours. Cells were characterized by increased number of Golgi apparatus and rough endoplasmic reticulum which could be associated with the plasma membrane. Nucleus could be enlarged and ameboidal (Fig. 4). The few multivesicular bodies observed in control samples enlarged in number and size with abscission and were mostly connected with highly branched plasmodesmata (Fig. 5).

1. SE Pattreson. Plant Physiology **126** (2001) 494-500.
2. SF Yang and NE Hoffman. Ann Rev Plant Physiol **35** (1984) 155-189.
3. FT Addicott. 1984. Abscission. University of California Press, Berkely.
4. JA Robertset et al. Annual Review of Plant Biology **53** (2002) 131-158.

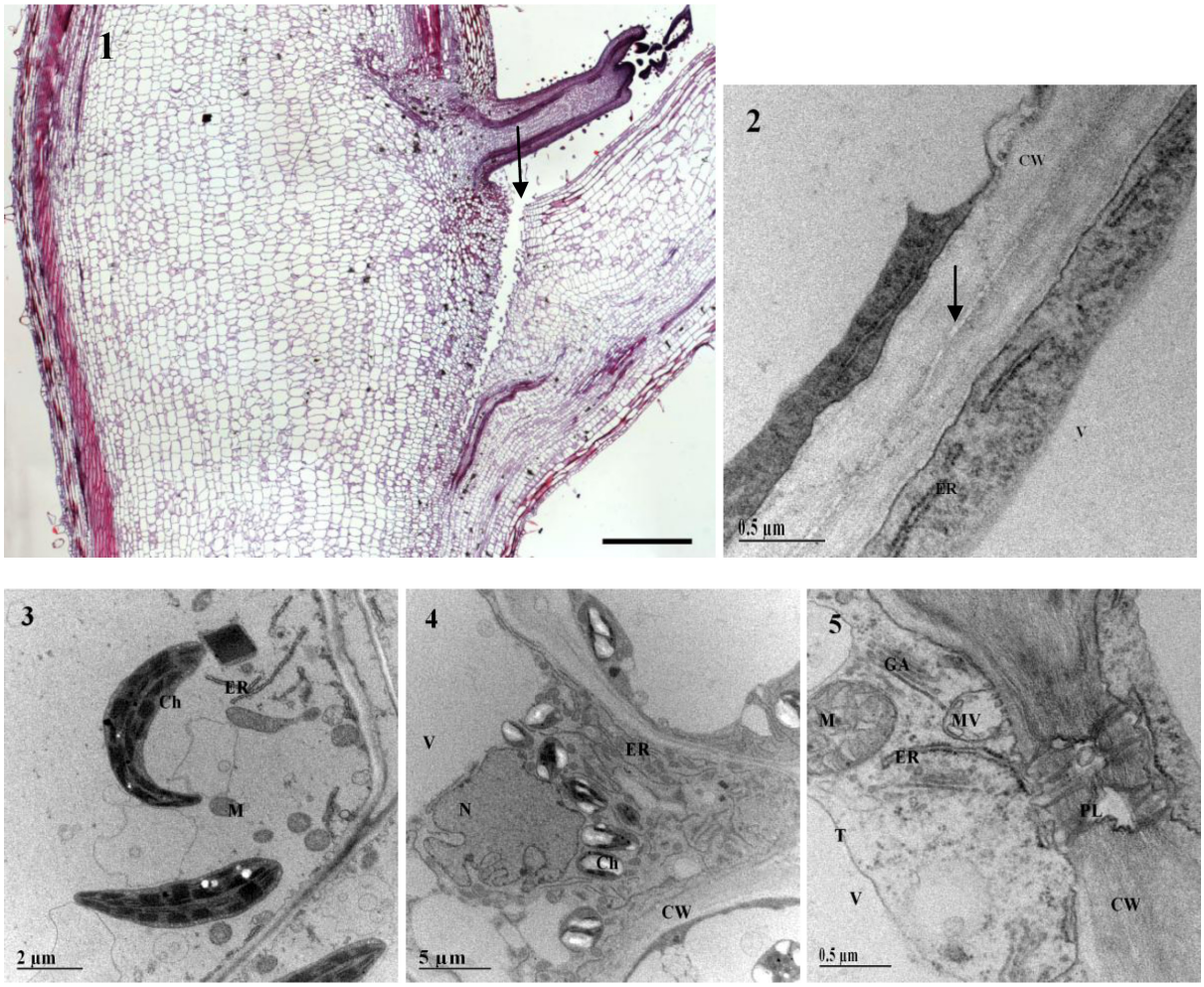

Figure 1. A typical area within the abscission zone (arrow) of tomato leaf is illustrated in a light-microscopic view (Zeiss Axioskop 2 microscope); scale bar: 1mm.
Figure 2. Dissolution of middle lammela (arrow); CW, cell wall; ER, endoplasmic reticulum; V, vacuole.
Figure 3. Disintegration of cell structure on leaflet part; Ch, chloroplast; M, mitochondrion; ER, endoplasmic reticulum.
Figure 4. Cell with enlarged nucleus (N) and a lot of endoplasmic reticulum (ER) in the cytoplasm; CW, cell wall; Ch, chloroplast; V, vacuole.
Figure 5. Plasmodesmata (PL) connected with endoplasmic reticulum (ER); CW, cell wall; M, mitochondrion; MV, multivesicular body; GA, Golgi apparatus; V, vacuole; T, tonoplast.

M.A. Pabst, G. Zellnig (Eds.): MC2009, Vol. 2: Life Sciences,
DOI: 10.3217/978-3-85125-062-6-218, © Verlag der TU Graz 2009