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SHORT COMMUNICATION

Development of the Abscission Zones in $j-2^{in}$ Pedicels of Galapagos Wild Tomatoes

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Summary

The abscission zone development in the pedicels of Galapagos wild tomatoes with $j-2^{in}$ gene was investigated anatomically by comparing it with that of a normal pedicel that forms the complete abscission zone. In normal pedicel, cells of the abscission zone formed initially when sepals were differentiating during flower bud development; in $j-2^{in}$ pedicel, they were formed at a later stage. In a normal pedicel at anthesis, the cells of the abscission zone were small, disk-shaped, and the epidermal tissue adjacent to the abscission zone was concave significantly toward the inner cortex. In contrast, in $j-2^{in}$ pedicel at anthesis, cells of the abscission zone were composed of isodiametric cells and the epidermal tissue was slightly concave. These results suggest that the $j-2^{in}$ gene delays abscission zone formation and development.

Key Words: abscission zone, Galapagos tomato, $j-2^{in}$, *Lycopersicon cheesmanii*, wild tomato.

Introduction

The wild tomato species, *Lycopersicon cheesmanii* which distributed only in the Galapagos Islands may prove to be an useful source of salt tolerance (Rush and Epstein, 1981) and high soluble solids content (Garvey and Hewitt, 1984) for plant breeders. One of the unique character of the Galapagos wild tomatoes is the presence of the arthritic articulation pedicels (Rick, 1967). This gene which was first discoverd by Joubert (1962), is different from that of jointless-2 (*j-2*) (Joubert, 1962) and is assigned the symbol $j-2^{in}$ for *j-2* with incomplete action. In this genotype, the abscission zone in the middle of the pedicel becomes swollen, unlike a normal pedicel, so that the flowers or fruits of Galapagos wild tomatoes are slow to abscise at maturity (Joubert, 1962; Rick,1967). Therefore, cells of the abscission zone of pedicel with $j-2^{in}$ gene seemingly do not initiate or develop completely compared to the normal pedicel. Because this process has not been investigated anatomically, we compared the formation and development of the abscission zone of Galapagos wild tomatoes with $j-2^{in}$ gene with the normal genotype.

Materials and Methods

Two Galapagos wild tomato accessions (*L. cheesmanii* Riley), LA317, with a normal joint pedicel, and LA1402, with a jointless pedicel manifested by $j-2^{in}$ gene were compared as to the timing of their abscission zone formation. Their flowers at anthesis were excised from the pedicel at the proximal side of the abscission zone as described in Hänisch ten Cate and Bruinsma (1973). The numbers of abscised flowers were recorded daily, and presented as a percentage in each accession. For the anatomical study, pedicels were collected from plants grown in the greenhouse, corresponding to the time when the sepal, petal, stamen, carpel, and ovules were differentiating and at anthesis. The pedicels were fixed in FAA solution (100% ethanol, 30% formaldehyde, and 30% acetic acid, 80:10:10, v/v), dehydrated with tertiary butyl alcohol series and embedded in paraffin. The 8 μm sections were cut and stained with 0.1% toluidine blue-O. The abscission zone of a pedicel was divided into four regions as described by Tabuchi (1998, 1999). More than ten sections at each stage of flower bud development were observed.

Results and Discussion

In LA317 with normal pedicel joint, 50% of flowers abscised in 2 to 3 days and 100% by 5 days, whereas in LA1402 with the $j-2^{in}$ gene, LA1402, 50% of the pedicels abscised in 12 to 13 days and 100% in 16 days. The results indicate that the abscission zones in pedicels with $j-2^{in}$ gene were slow to develop as reported in Joubert (1962).

In a normal pedicel plant, LA317, cells of the abscission zone were initiated while the sepals were differentiating during flower bud development (Fig.1A). The cells were irregular in shape, smaller in size than the adjacent tissue cells and their nuclei stained darkly. They originated in the central parenchymatous region about 10-15 cell layers depth from the epidermal layer of flower bud apex as in the common tomato (*L.*

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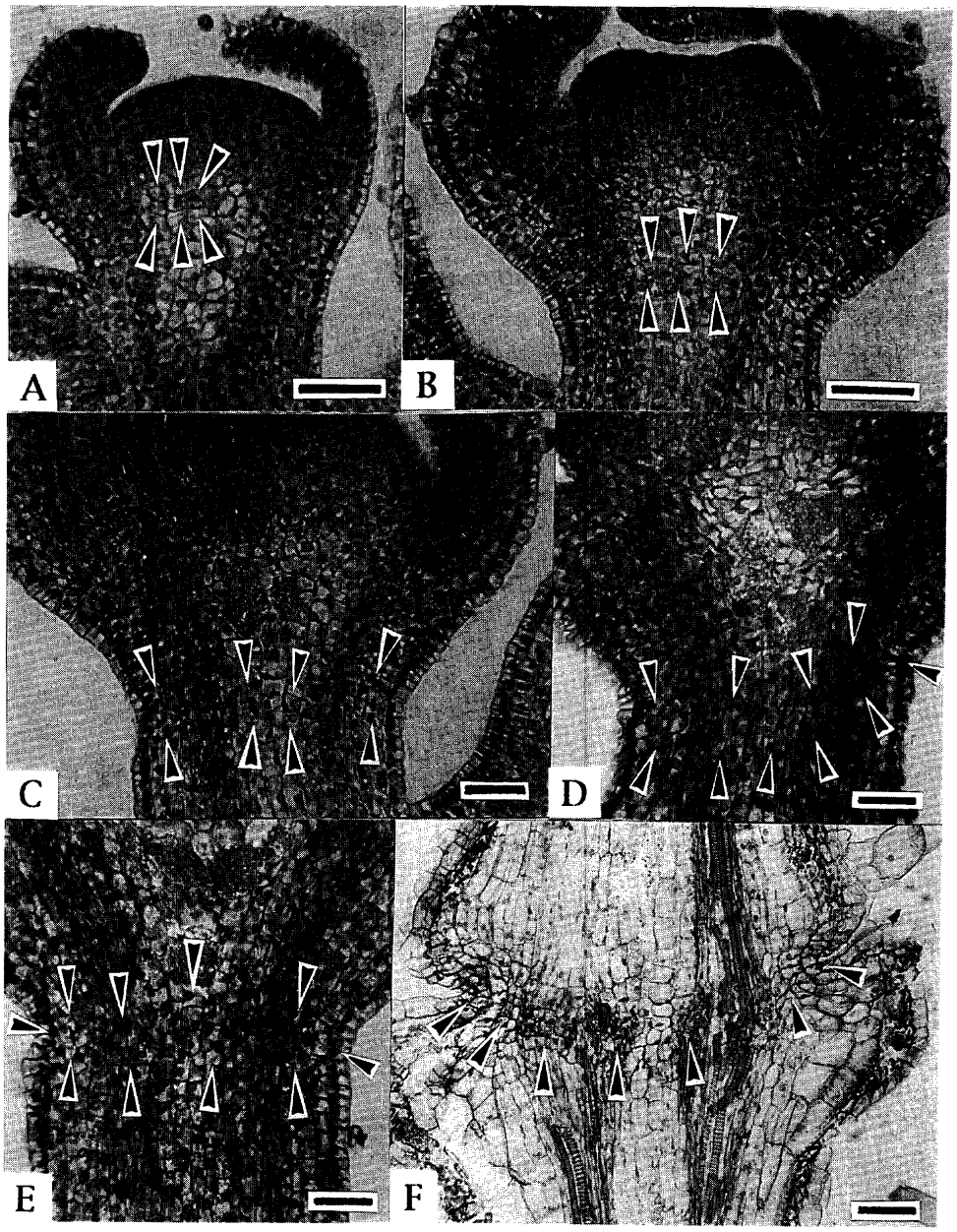

Fig. 1. Initiation and progression of the abscission zone in normal pedicels of Galapagos wild tomato plants, LA317.
Longitudinal sections of pedicels during the differentiation of: sepal (A), petal (B), stamen (C), carpel (D), ovule (E), and at anthesis (F). Arrows indicate the abscission zone. Scale bar = 100 μm.

esculentum Mill. cv. Tiny Tim Red) (Tabuchi, 1999). However in LA1402, cells of the abscission zone were detected initially when the carpel was differentiating (Fig. 2D). These cells were somewhat similar to those of LA317 in that their nuclei stained darkly, but their size and shape were almost the same as the adjacent parenchymatous cells. Therefore, these cells were difficult to detect at the early stages of flower bud development. These results indicate that the onset of the abscission zone formation in the pedicels with $j\text{-}2^{in}$ gene was later than that of the normal pedicel. In both accessions, as the floral stage proceeded, cells of the abscission zone expanded radially toward the epidermal region of pedicel (Fig. 1A-F, 2D-F). At anthesis in LA317 (Fig. 1F), the abscission zone in the parenchymatous region was 4 to 6 cell layers thick and consisted of small, flat cells with condensed cytoplasm. Epidermal tissue at the abscission zone of the pedicel was significantly curved towards the inner cortex tissue. In contrast, in LA1402 at anthesis (Fig. 2F), the cells of the abscission zone in the central cortical zone were compact and isodiametric; the epidermal tissue at abscission zone was slightly curved. We conclude that the $j\text{-}2^{in}$ gene delays the formation and development of the abscission zone.

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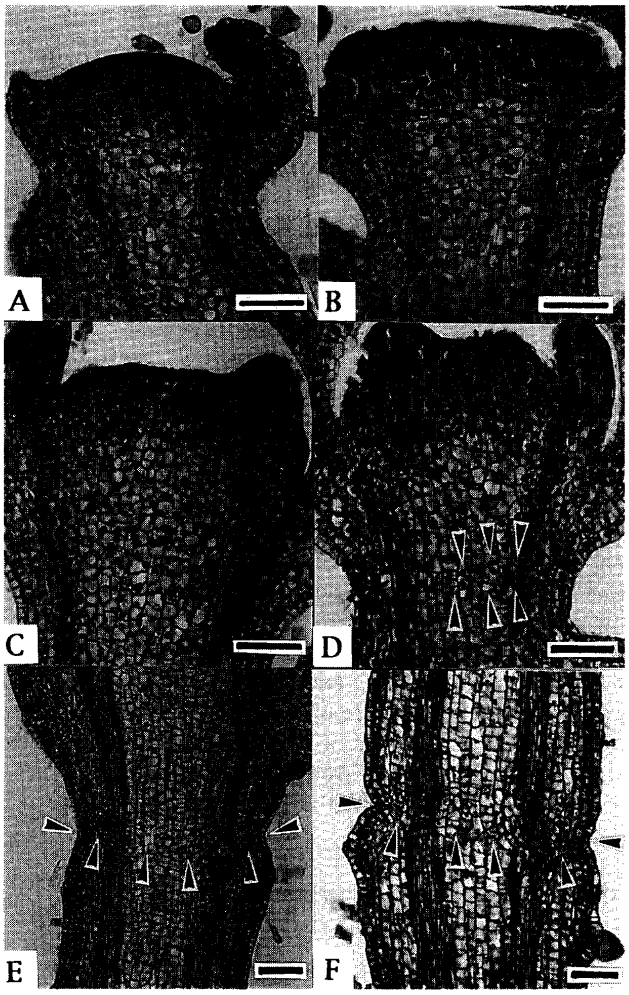

Fig. 2. Initiation and progression of the abscission zone in $j\text{-}2^{in}$ pedicels of the Galapagos wild tomato plants, LA1402.
Longitudinal sections of pedicels during the differentiation of: sepal (A), petal (B), stamen(C), carpel (D), ovule (E), and at anthesis (F). Arrows indicate the abscission zone. Scale bar=100 μm.

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$j\text{-}2^{in}$遺伝子を有するガラパゴス産野生種トマトの小花柄における離層の形成と発達

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摘　要

$j\text{-}2^{in}$遺伝子を有して小花柄に離層を形成しない系統LA1402と，ガラパゴス産野生種トマトで正常に離層形成・発達する系統LA317を供試した．開花時に花を切除して小花柄の脱離時期を比較した結果，LA317では処理後5日目で全ての小花柄が脱離したが，LA1402では脱離しなかった．LA1402の小花柄の脱離は処理後5日目に始まり，16日目にすべて脱離した．離層細胞の分化開始時期は，LA317ではがく片形成期で，LA1402では心皮形成期であった．開花時の離層細胞は，LA317では軸方向に扁平で離層の表皮組織が小花柄の中心部に向かって著しく窪んでいたが，LA1402では離層細胞が球状で離層の表皮組織の窪みの程度がわずかであった．従って，$j\text{-}2^{in}$遺伝子を有するトマトLA1402の小花柄が脱離しにくいのは離層細胞の分化開始時期が遅く，その後の発達が不完全であることに起因しているものと推察された．