

A Comparison of Normal Seeds and Pseudoembryos Produced in Parthenocarpic Fruit of 'Severianin' Tomato¹

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Abstract. Pseudoembryos, produced from endothelial proliferation, were found in parthenocarpic fruits of 'Severianin' tomato (*Lycopersicon esculentum* MILL.). The pseudoembryos did not increase in size after 12 days after anthesis and no endosperm or embryo occurred. At maturity, pseudoembryos became yellow-white in color and had developed a seed coat and thickened radial walls which appeared like hairs. Parthenocarpic fruits had complete locular development, similar to seeded fruits.

'Severianin' is a tomato line from the U.S.S.R. which exhibits facultative parthenocarpy (functional seedless fruits) in some environments (8). These seedless fruits contain a pseudoembryo. Pseudoembryos also developed in auxin-induced parthenocarpic tomato fruit (1, 2, 7), with the development of seed coats at fruit maturity (7). This paper compares the development of normal seeds with pseudoembryos produced in separate fruits on the same 'Severianin' tomato plant.

'Severianin' plants were grown in the greenhouse and: a) hand-pollinated to produce seeded fruit; b) emasculated but not pollinated; or c) not pollinated. Unpollinated flowers of 'Severianin' produce parthenocarpic fruit with pseudoembryos (8). Young fruit (12 days after anthesis) and mature seeded and seedless fruit were embedded in paraffin and sectioned at 10 to 15 μ to compare endosperm and embryo development. Staining (picric acid-gram stain) followed the method described by Smith (10) and Johansen (6).

Pseudoembryos found in 12-day-old parthenocarpic fruits of 'Severianin' tomato had no endosperm or embryo. The location of the original embryo sac was occupied by endothelial or integument tissue (Fig. 1). Endothelial proliferation occurred and formed a defined but very small green structure which did not increase in size after 12 days after anthesis. As fruits reached maturity, the pseudoembryos became yellow-white in color and developed a seed coat (Fig. 2). The radial

walls of the outer epidermis of the integument remained and formed hairs (3) (Fig. 2). Similar pseudoembryos were found in fruits which developed from emasculated flowers of 'Severianin' tomato. This suggests that during the development of parthenocarpic fruits in 'Severianin', the fertilization process does not occur. The anatomical development of the pseudoembryos in 'Severianin' and auxin-induced parthenocarpic fruits produced in other cultivars is similar (4, 7).

In normal cultivars, the fruit initially consists of pericarp and ovule tissue. Fertilization occurs about 25 hr (5) after pollination and the endosperm nucleus begins division before the embryo. By 94 hr after pollination, a 2-celled embryo has formed and the endosperm consists of 25 to 30 cells (10). In normal seeds of 'Severianin' tomato, a very defined embryo was observed 14 days after

anthesis (Fig. 3) and a normal seeded structure had been produced by 28 days after anthesis. Thus, seed development in 'Severianin' fruit containing seeds was similar to that which occurs in standard cultivars (10).

The development of the pseudoembryo in parthenocarpic fruits of 'Severianin' was found to be similar to that which occurs in hormone-induced parthenocarpic fruits of other cultivars (1, 2, 7, 9). In these cultivars, ovules contained a collapsed embryo sac in the seed residue of the parthenocarpic fruit 12 days after auxin-treatment; the embryo and endosperm failed to develop and the megagametophyte disintegrated (2, 4). However, integument cells developed rapidly and at 302 hr after pollination had differentiated to the same degree as those of pollinated fruits (4). By maturity, a normal seed coat had formed but no development of the endosperm occurred and no trace of embryo was found (4, 7).

In the embryo sac cavities of the pseudoembryos found in the parthenocarpic fruit of 'Severianin', no embryo or endosperm were found. The ovule apparently collapsed and the cavity contained few cells (Fig. 1 and 2). If fertilization did occur, dividing cells in the endosperm would be expected as well as a marginal layer of embryo sac between these cells and integument tissue.

Auxin-induced parthenocarpic fruit in tomatoes often results in poor development of the gelatinous pulp, and puffy insipid flesh occurs (1, 2). Naturally produced parthenocarpic fruit of 'Severianin' had complete locular development, with fruit size and weight comparable to seeded fruits of 'Severianin'. Occasionally, some 'Severianin' fruits produced locules which contained seeds and some which did not, but this uneven distribution of seeds did not affect fruit shape. Thus, seeds are not important for the natural development of tomato fruit in this mutant.

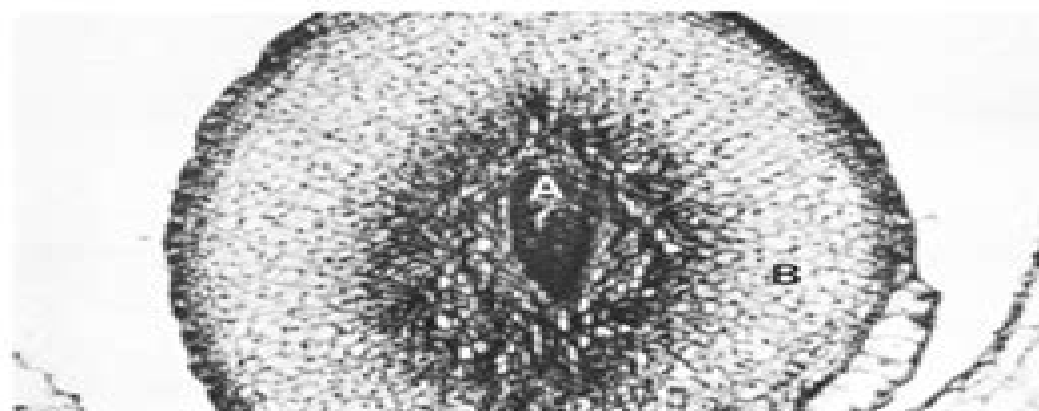


Fig. 1. Longitudinal section of the pseudoembryo from parthenocarpic fruit of 'Severianin' 12 days after anthesis. A: location of embryo sac containing nucellus tissue. B: integument tissue. $\times 120$.

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web indexing in matlab is column wise for example a matrix $a = \begin{bmatrix} 2 & 9 & 4 & 3 & 5 & 11 \end{bmatrix}$ is stored in memory as the array 2 3 9 5 4 11 one

can use a single index to access an element of the matrix e.g. $a_{4,5}$ in matlab there are two matrix systems to represent a two dimensional grid the geometry consistent matrix and the coordinate consistent

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