

# Pollination & Fruit Development in Tomatoes

## Pollination and Fruit Set

Development of high-quality tomatoes requires pollination. Pollen produced in the anthers is transferred during pollination to the stigma of the flowers (Figure 1). The pollen then germinates and the pollen tube grows through the style reaching the ovules. The ovary protecting the ovules enlarges and develops into the tomato fruit.

Several factors influence the success of the pollination process. Sufficient amounts of viable pollen must be produced in the anthers and transferred to the stigma. At the time of pollen transfer, the stigma must be receptive to allow rapid pollen germination and growth through the style. The pollen tube must reach the ovules for the ovary to increase in size

Failure in any of these processes prevents normal fruit development. The symptoms of unsuccessful pollination are “dry set” or rough fruit. Adverse environmental conditions such as temperature, light and humidity or poor nutrition can also result in inadequate pollination.



Photo by Penny Greb, USDA ARS

## Environmental Conditions

### Temperature

Greenhouse temperatures during the pollination period should not fall below 60°F at night or exceed 85°F during the day. At higher or lower temperatures, pollen germination and pollen tube growth are greatly reduced. Night temperatures are particularly important.

### Light

Dark, cloudy weather retards pollen development and germination to reduce the fruit set in many tomato varieties. Since tomatoes are self-pollinated, the length of the pistil affects the ease with which pollen is transferred from the anthers to the stigma. If the pistil and style are short, the stigma is surrounded by the pollen sacs of the anthers to ease

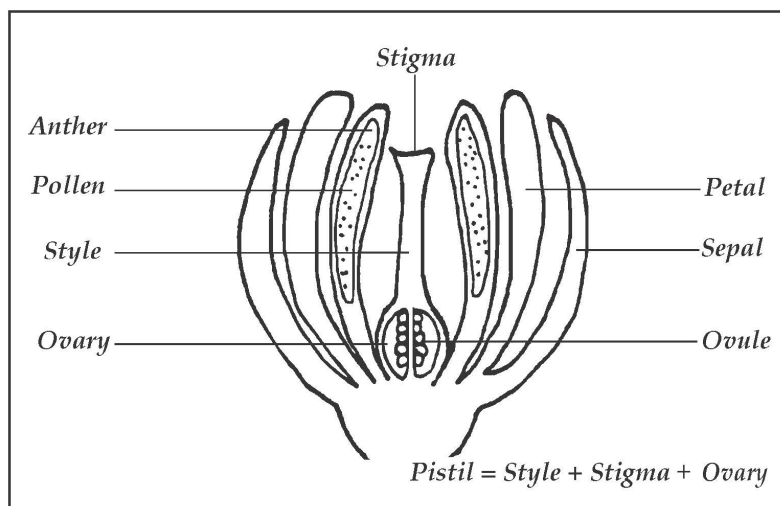


Figure 1. Schematic drawing of tomato flower parts

pollen transfer (Figure 2). In some tomato varieties, the style and stigma extend beyond the anthers, making adequate pollen transfer difficult. Higher solar irradiance tends to increase yields of tomatoes while the styles of the flowers grow shorter. A combination of low carbohydrate and high nitrogen content in the plant tissue, on the other hand, often results in long style lengths. These conditions are common under prolonged low light with high soil fertility.

### Humidity

Relative humidity of 70 percent is optimal for pollination, fruit set and development. Very high humidity keeps the pollen too damp and sticky, reducing the chance of sufficient pollen transfer from anthers to stigma.

### Pollen Transfer

Assuming satisfactory environmental conditions and nutrition, the main factor for good fruit set is adequate pollen transfer. In the garden, air movement or insect pollinators ensure sufficient pollination. In a greenhouse with less air movement, mechanical pollination assistance may be needed. Battery-operated or electric hand-held vibrators have been used. These can be made from, for example, an electric toothbrush or a doorbell solenoid, or purchased from greenhouse supply houses. The vibrating probe, momentarily held against the branch of the flower cluster, shakes it with moderate vigor. Recently opened flowers

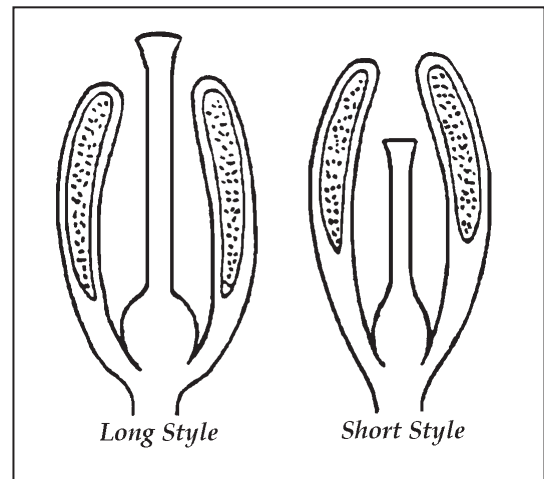


Figure 2. Style length may affect pollination

disperse the pollen in a small yellow cloud. To disperse pollen from newly opened flowers, branches must be regularly vibrated at least every other day.

Methods that are less labor intensive tend to be less efficient for aiding pollination. Agitating the support strings or wires to shake the plants does not achieve good pollination. Mechanical blowers may be used, but tomato quality and yield are inferior to quality and yield from plants pollinated by individual cluster vibration. Excessive airflow can damage plants and direct the dispersed pollen away from the flowers. For blower pollination, the airflow should duplicate the flower cluster agitation of a battery or electric hand-held vibrator. Directing the air stream at individual clusters 7 to 8 feet down the row will provide better results than indiscriminately brushing plants with the air stream. A simple tapping or vibrating of flower clusters should be satisfactory in a greenhouse with a limited number of tomato plants.

### Blossom End Rot

This is a physiological disorder. Inadequate calcium combined with moisture stress results in a gray-black discoloration at the blossom end of the fruit. Maintaining an even soil moisture supply is the best preventative technique.

## Fruit Cracking

Symptoms of this stress problem are usually cracks radiating from the stem that almost always occur on maturing fruit from a few days before pink color to the red-ripe stage. High-temperature cracking is probably the result of a heat-caused breakdown of epidermal tissues around the stem. Susceptibility to fruit cracking is known to be an inherited characteristic. Plant breeders have succeeded in developing at least moderate resistance in most modern varieties.

Fruits of most varieties will crack at excessively high fruit temperatures and during sudden changes in the supply of soil moisture. Lack of foliage and increased exposure to light can result in high fruit temperatures. Irrigation following low soil moisture conditions may result in sudden water uptake with sufficient internal pressures to crack the fruit. Prevention, therefore, lies in selecting varieties for maximum resistance, avoiding high fruit temperatures and maintaining uniform soil moisture conditions.

## Blotchy Ripening

Blotchy ripening is also known as gray wall or internal browning. Blotchy ripening is characterized by uneven coloring of the fruit wall in the form of irregular, light-green or almost colorless areas. Brown necrotic areas are frequently found in the tissue inside the fruit.

Blotchy ripening is associated with conditions of low light intensity, cool temperatures, high soil moisture, high nitrogen and low potassium levels. While these conditions may contribute separately to blotchy ripening, combinations are likely to produce the greatest symptoms. Some varieties are more susceptible than others. To avoid blotchy ripening when light is low, reduce irrigation and fertilizer (especially nitrogen) and maintain day temperatures of no more than 10° to 15°F over the minimum night temperature. If blotchy ripening occurs under moderate to high light intensity, the cause may be nutritional (high nitrogen, low potassium levels) or high soil moisture.



Photo by Mason Masteka

## Sunscald, Orange Fruit Color and Green Shoulder

These disorders are associated with high temperatures and high light intensity. Fruit temperature in areas exposed directly to the sun can be considerably higher than the surrounding air temperature. Avoid removing leaves that provide protection to fruit clusters during extended periods of high-angle sun exposure.

*Sunscald* occurs in large circular areas on exposed fruit shoulders. The internal cells in these areas have been adversely altered by high temperatures or high-energy short-wave radiation from incoming sunlight.

*Orange fruit color* following ripening can be attributed to the inhibition of the formation of the red lycopene pigment at prolonged high temperatures. Carotene, the main yellow-orange pigment, is unaffected by temperature. The best temperature for the development of red pigment and tomato color is between 65° and 75°F.

Some tomato varieties have an inherited characteristic and tendency for developing fruit with *green shoulders* while other selections ripen more uniformly.

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