



## TULIP BREAKING OR MOSAIC

Tulip “breaking” is an old term that refers to an unusual mosaic pattern of petal colors. Typically, dark colors appear on a lighter colored background, with the patterns of the darker colors being irregularly broken into stripes, flecks, or featherings (Figure 1). The condition is caused by one or more viruses, and because it is not genetically induced, the patterns vary greatly. In bicolor tulips, however, the coloration is genetic, and the patterns vary greatly. In bicolor tulips, however, the coloration is genetic, and the pattern, therefore, is uniform and predictable for the variety. Double-flowered tulip varieties are more susceptible to tulip breaking or mosaic than are single-flowered ones.



*Figure 1. Tulip breaking caused by a virus. Plants gradually weaken and should be destroyed to prevent spread to healthy tulips.*

Tulip breaking is caused by one or more viruses in the potato virus Y group including tulip breaking virus, arabis mosaic, lily symptomless, potato virus X, and tulip virus X, a multicomponent virus, by the cucumber mosaic virus, or possibly by other viruses and occurs wherever tulips are grown. It is the second oldest known viral disease of plants, being first described in 1576. Symptoms were pictured in early wood cuts. As early as 1619, Dutch and Flemish painters, including Rembrandt, Jan Davidsz deHeem, and David Seghers, painted portraits and still lifes that included tulips which clearly showed variegation (mosaic) in flower color patterns. A craze in Holland between 1634 and 1637, called “tulipomania,” developed to such an extent that a single bulb of a mosaic type tulip sold for as much as \$880.00. Fortunes were quickly lost in the tulip market when it was discovered that flower color breaking could be induced simply by grafting the bulb of a highly prized mosaic type to a common type. It was not until 1928 that the cause of tulip breaking was identified as being viral in nature. Today, many commercial varieties, including the so-called “parrot,” Bizarre, Bijbloemen, and Peppermint Stick tulips are naturally infected and produce “broken” or mosaic-affected flowers. The Rembrandt variety is a virus-infected strain of the variety Princess Elizabeth.

### SYMPTOMS

The primary symptom is a change in color pattern of dark-pigmented flowers. It is caused by a redistribution of epidermal anthocyanin pigments, segregating them into fine marginal featherings or

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irregular stripes, bars, broad streaks, blotches, or “flames.” Between the stripes and streaks appear patches of pure white or yellow. Both the sepals and petals are affected (Figure 1). Often this “broken” color is restricted to a pencilling of the margins and tops of the petals and sepals. All pink, red, and purple flowers develop striking color changes. Dark-colored tulips develop even darker stripes. White- and yellow-flowered varieties, however, do not break because anthocyanin pigments are absent. Diagnosis by symptoms is not reliable since some infected cultivars are symptomless.

Some, but not all, infected tulip varieties also show a chlorotic streaking or mottling of the leaves and flower stems. This mottling may be so indistinct, however, that it is visible only in subdued light. The mottling first consists of streaks that are silver-gray to light green. Gradually, the striping becomes more pronounced (especially between the leaf veins), until much of the chlorophyll in the affected leaves disappears. The leaves become a silvery or light grayish green to yellowish. Without the chlorophyll, they may even wilt.

Affected plants may be somewhat stunted and less vigorous. They produce fewer offsets or bulbils, and their flowering is usually delayed a week to 10 days longer than that of virus-free plants. They do not, however, die from the disease.

## **Cause and Transmission**

Tulip breaking is due to one or more viruses occurring as strains of varying severity. Transmission of the virus (or viruses) is usually by the feeding of several species of aphids, but particularly the green-peach aphid (*Myzus persicae*), *Macrosiphium euphorbiae*, and *Dysaphis tulipae*. The virus, or viruses, can also be easily spread when, for example, a healthy flower stem is cut with the same knife used to cut an infected stem, or when bulbs are plugged with virus-infected tissue. Transmission through seed has not been reported.

In commercial production, the appearance of current-season symptoms can be accelerated by inoculating plants soon after the leaves emerge, either by the sap transmission method or with virus-carrying aphids.

## **CONTROL**

1. Dig up (rogue) and destroy diseased plants and bulbs as soon as mosaic-infected leaves or broken flowers are found. This can usually be done before aphids appear, feed, migrate, and thus threaten the infection of nearby healthy tulips.
2. Sprays of mineral oil are often advisable to help insure freedom of tulip plantings from aphid feeding.
3. Broken tulip varieties should not be grown either near tulips with solid colors or near lilies. Some of the same viruses infect both lilies and tulips, and each host plant can act as a source of infection for the other.
4. Plant bright-colored pink, red, purple, and brown tulips in separate beds from dark-colored, white, or yellow varieties.
5. Keep down weeds that may harbor one or more tulip-infecting viruses.