FUSARIUM in TULIPS

How to identify Fusarium infection in tulip bulbs and manage its wrath through non-chemical means.

By Bill Miller

Tulip forcing in 2002 has been difficult. In many greenhouses, tulip crops were uneven and, overall, very short. Upon flowering, many pots had one or more stems with blind shoots, where the bud may have been aborted at a relatively late stage (perhaps when it was 1/2-inch long) or at a much earlier stage, where only a blackened stump and tiny remnants of a very small flower were present. In either case, the value of the product was severely compromised. These kinds of problems were seen in both pot and cut crops, and in landscape plantings as well. A major culprit in all these problems is Fusarium, an important disease in many bulb crops, but one that poses special problems for tulips.

In an earlier article in *GPN* ("Flower Bulb Transportation and Handling," August 2001), the relationships of Fusarium infection, ethylene production and forcing problems were introduced. In this article, we'll review some of the known information on Fusarium infection in tulip bulbs and describe some non-chemical remedies for its management.

RECOGNIZING FUSARIUM INFECTION

The most common Fusarium in tulips is *Fusarium oxysporum* Schlecht. *f. sp. tulipae*, and it can be a problem wherever tulip bulbs are produced. Tulip bulbs infected with Fusarium are easily recognized because of the black appearance of infected bulbs. Another easy way to detect Fusarium is to smell the bulbs. Infected bulbs have a distinct, sour smell as a result of the fungus degrading the bulbs' tissue. They may also have white mycelium (mold) growing on the surface, and this is usually concentrated on the basal part of the bulb. Still other bulbs may be very lightweight as a result of the fungus consuming the starches and other scale components. Bulbs with a severe infection might show a somewhat opened bulb tip with the protruding leaves dried out. Multiple fungi can be present on a tulip infected with Fusarium, for example, Pennicilium. This fungus is distinguishable from Fusarium as it is bluish-green. With only superficial growth on the bulb's surface, Pennicilium is not a major problem.

Top: 'All Seasons' tulip with one stem showing an aborted flower bud (lower right). This is an example of "kernrot," a disorder involving mite injury on the primordial flower bud. Bulbs that are exposed to ethylene react with a small amount of shoot growth, enough to open the tip of the bulb. This opening gives an entry point for mites to crawl in and begin feeding on the young bud, leading to its death. Injury is expressed as a blackened stump at the time of flowering; Above left: Tulip bulbs showing severe Fusarium infection. Note progression of the disease from the base; Above right: The bottom of tulip bulbs showing well-developed Fusarium infections. In both cases, but especially in the bulb on the right, injury to the root collar is evident. If cut open, the basal plate of the right bulb would be seen to be severely injured, and the bulb would not flower properly. (All photos courtesy of Bill Miller)

FIELD AND PRODUCTION FACTORS

Infection of tulip bulbs by Fusarium is more likely during growing seasons with high soil temperatures from the period of flowering (i.e., early May) until digging in late June to mid-July. Thus, Fusarium is exacerbated in warmer growing seasons. Past research has indicated that later digging tends to increase Fusarium infection due to the normal increase in soil temperature in late spring. On the other hand, early harvesting to avoid warm soil temperatures is not an answer, as bulbs are not properly mature with early digging.

In the case of Dutch production, there are many ➧

suggestions as to the sudden increase in Fusarium over the past two seasons, including changes in farming practices and bulb handling equipment; regulatory changes affecting fungicide availability; buildup of spore and inoculum in the soil; and possibly the appearance of one or more "new" Fusarium strains that could be more resistant to fungicides and/or generally more aggressive in their infection and spread.

FUSARIUM, GUMMOSIS AND ETHYLENE

Aside from direct effects of the fungus on a bulb, a much larger problem comes from the fact that the Fusarium produces a large quantity of the plant hormone ethylene. Ethylene can have several negative effects, including flower abortion, uneven, stunted growth, reduced rooting and gummosis (external or internal blobs of a clear to brownish-tan substance that ultimately hardens like peanut brittle, without the peanuts, of course). In severe cases, the external "gum" can cement numerous bulbs together into a cluster (more like peanut brittle!). Often, the gummosis is only produced inside the bulb ("internal gummosis"), filling up the spaces between the bulb scales. The bulb must be cut open to see internal gummosis.

Another confounding factor in the diagnosis of ethylene problems is the timing of ethylene exposure. Gummosis is more commonly expressed in tulips exposed to ethylene shortly after digging, that is, in mid- to late July. The same cultivars exposed to ethylene late in the season (for example, after shipment to the United States) will often not develop any gummosis at all, but may still show 100-percent flower abortion upon forcing.

While most of the symptoms of tulip ethylene exposure are deleterious (e.g., flower abortion), others are not specifically problematic (e.g., gummosis). If the flower of a tulip cultivar aborts due to ethylene exposure, the bulb is obviously worthless. On

Top: Tulips with Fusarium infection, exhibiting the characteristic opening on the top of the bulb due to ethylene generated from the Fusarium; Bottom: "Gummosis" of tulips. These bulbs (three different cultivars) show symptoms of external gummosis, or leakage of polysaccharide-like material from the bulb. Gummosis is a clear indicator that the bulbs have been exposed to ethylene. However, in some cases, ethylene does not lead to gummosis and some bulbs with gummosis will still bloom.

the other hand, the presence of some gummosis is not an indication the shipment should be refused. Cultivars vary in their sensitivity to ethylene and their expression of gummosis symptoms. For example, certain tulip cultivars may exhibit gummosis upon ethylene exposure but are somewhat immune to flower abortion from the same ethylene. Thus, the presence of gummosis in a cultivar in a shipment only indicates that that cultivar was exposed to ethylene (which probably occurred well before shipment), but it does not specifically indicate that the entire shipment was exposed, nor does it specifically mean that the affected bulbs will show problems upon forcing.

Due to the complex interaction of cultivar, symptom expression and varying times after digging when these problems can occur, you should immediately contact your supplier if you receive a shipment with a substantial proportion of Fusarium or gummosis tulips. Long-standing advice has been to seriously consider discarding the lot if more than 10 percent of the bulbs are infected by Fusarium. This is, again, due to injury from the large quantity of ethylene that can be produced from the infected bulbs.

WHAT TO DO?

Since Fusarium-infected bulbs continue to produce ethylene after planting, such bulbs can injure other bulbs within a pot or a cut flower forcing crate. Thus the old adage that one bad apple spoils the batch applies equally well to planted tulips.

During planting operations, bulbs should be inspected, and those showing any signs of Fusarium infection should be discarded. Also discard any bulbs that are "light" (having been consumed already by the fungus) and any with a sour smell (sure evidence of Fusarium actively working on the bulb). It cannot be emphasized enough how important this step can be to help with uniformity of the pot or cut flower crate during forcing. The utility of dipping or drenching with fungicides by U.S. forcers is questionable, as the injury resulting from ethylene exposure has already mainly occurred. GPN

Close-up of a tulip bulb with gummosis.

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