

GROWERTALKS

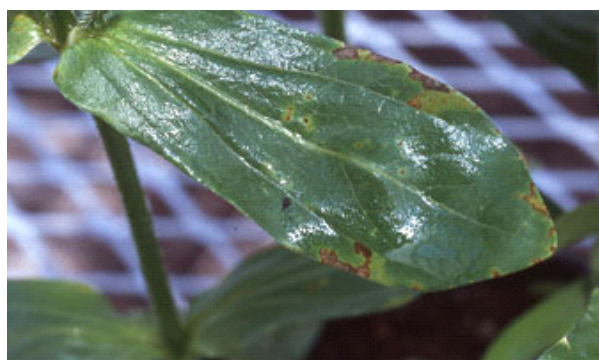
Pest Management

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Fazed by Zinnia Spots? This May Be Why

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Zinnia leaf and flower blight caused by *Xanthomonas campestris* pv. *zinniae* (*X. c. zinniae*) is so familiar today that it's rarely studied. Luckily, it causes only localized spotting and none of the systemic effects found with the bacterial diseases of geraniums and begonias caused by other (different) *Xanthomonas* strains. All too often, though, this bacterial disease of zinnia steals the profitability of one of the most popular bedding plants by causing ugly spots on leaves, stems and flowers.



Pictured: Infections caused by X. c. zinniae first show as tiny, water-soaked spots on leaves or petals. There's often a yellow halo around each individual roundish lesion.

This bacterial disease was first noted in Italy in 1929 and the pathogen was identified in Southern Rhodesia in 1949. It was first found in North America in Ohio and North Carolina in 1972. Over time, it has been found in many countries around the world, including Australia, Brazil, India, Malawi and Sierra Leone. Recently, it reappeared in Europe and first reports were also published from China and Korea, where the disease caused conspicuous symptoms on garden plantings of zinnia. In the United States, this disease is seen often in gardens and occasionally in greenhouses, particularly towards the end of the production season when temperatures are warmer.

Symptoms

Infections caused by *X. c. zinniae* first show as tiny, water-soaked spots on leaves or petals, just a few millimeters in diameter. There's often a yellow halo around each individual roundish lesion.

Symptoms tend to appear first on the lowest leaves. Older spots may be larger, angular, brown patches bounded by the leaf veins, which may dry to a tan color. Under disease-conducive environmental conditions (warm and humid), new spots will begin to appear only four to eight days after bacteria have splashed onto the leaves—imagine how fast the symptoms can multiply in greenhouses with overhead watering in late spring!

In a plug tray, infection may appear first on cotyledons, which may dry up and fall away. This means that the presence of the bacteria may go unnoticed until the environment changes and there's another wave of symptoms on older plants.

Seed transmission

This bacterial disease is so persistent in the flower industry largely because the pathogen may contaminate the surface of seed. The bacteria may also be harbored within organic debris associated with poorly-cleaned seed.

Almost 40 years ago, Dr. David Strider at North Carolina State University worked extensively with this disease, demonstrating conclusively that it was seed-borne. He also attempted to find effective controls and determined that a seed soak in 10,500 ppm sodium hypochlorite (the active ingredient in bleach) would disinfest zinnia seed effectively.

Seed companies are generally loath to do a seed treatment that will lower germination even slightly—it's hard to choose between preventive disease management and a predictable, near-perfect seedling stand. Dr. Strider ruled out streptomycin seed treatments because they caused a temporary chlorosis and stunting of zinnia seedlings, and ruled out hot water soaks because the effective temperature for eliminating the bacteria significantly reduced germination.

Environmental factors

The bacteria are favored by warmth and are able to grow at temperatures as high as 95F (35C). Often the problem escapes notice early in production, only to cause symptoms on zinnias being finished in pots for later -season sales. Symptoms are frequently noticed just as plants begin to flower.

The disease is also regulated by moisture availability; water splash from irrigation, crowding and poor air movement will encourage disease development and spread. During dry periods in the garden, the disease will be quiescent, whereas rainy summers cause the disease to be all too evident.

Host range

The bacterial leaf and flower spot of zinnia is a disease that we've thought of as host-specific, but modern studies have shown this to be only a partial truth. This disease has been seen to occur naturally only on zinnia, but Chinese researchers recently observed symptoms on *Aster tataricus* (tatarian aster), *Rudbeckia hirta* (Black-eyed Susan) and *Bellis perennis* (English daisy) when they inoculated plants with *X. c. zinniae* collected from spotted zinnias. None of the 19 non-asteraceous plants they inoculated developed symptoms.

Most alarmingly, studies in Ohio have shown that tomato can also be a host; cabbage, lettuce, pepper and radish plants inoculated under the same conditions did not develop symptoms.

Management

Until there's a rainbow assortment of *Zinnia elegans* bred to be resistant, the key to managing this disease is to tightly control the pathogen in the seed production fields or to treat the seed after harvest to remove bacterial contamination. Over half of the commercial seed lots tested in the early 1970s were found to be

contaminated at a low percentage with *X. c. zinniae*, but seed quality appears to have vastly improved in this respect. Once the spots show up in a greenhouse zinnia crop, the only recourse is to discard the plants showing symptoms and treat the rest to fend off the disease.

Few treatments are available for bacterial disease control; copper fungicides give some benefit if the bacterium hasn't become resistant, but many of them leave a conspicuous residue. Another option is the biological control *Bacillus subtilis*, which may be applied as various formulated products alternated with copper sprays.

Keeping leaf surfaces as dry as possible is critical for getting control of a *Xanthomonas* outbreak. Subirrigate, use trickle irrigation or water carefully by hand early enough that foliage dries before nightfall. Space plants well and have good air movement in the greenhouse.

Now that we know tomatoes may be infected by this bacterium, it would be wise to grow zinnias apart from tomatoes, lest the inoculum be shared from one crop to another.

Monitoring can be very valuable, particularly in the first two weeks after seeding. Watch plug trays closely for any sign of spotting and pull out contaminated trays. It's best to get a disease diagnosis before disposing of quantities of plants; the *Alternaria* leaf spot can look similar to the bacterial leaf spot and preventive treatments are different for the two diseases.

In the landscape, control of bacterial leaf and flower spot is best done by planting resistant or non-host plants and choosing open, sunny sites to grow zinnias. **GT**

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