

## Bacterial Wilt of Ginger and Ginger Relatives *Ralstonia solanacearum*, Race 4

**Hosts:** Ginger (*Zingiber officinale*) and ginger relatives; red and pink ginger (*Alpinia purpurata*), white ginger (*Hedychium coronarium*), red ginger lily (*Hedychium coccineum*), *Globba* spp., Siam tulip (*Curcuma alismatifolia*), and spiral ginger (*Costus barbatus*).

**Disease common name:** Bacterial wilt of ginger.

**Pathogen:** *Ralstonia solanacearum*, race 4; syn.: *Pseudomonas solanacearum* and *Burkholderia solanacearum*.

### Disease Cycle

**Inoculum:** Infected ginger rhizomes used as seed pieces for the subsequent crop and/or contaminated soil are major sources of primary inoculum.

**Transmission:** The pathogen is spread principally through movement of infected rhizomes used as seed pieces for the subsequent crop. It also is disseminated by contaminated soil on tires, farm equipment, and footwear. Also, irrigation water can carry inoculum from infected to healthy plants.

**Infection:** Infection takes place through small wounds or natural openings in roots. The pathogen then colonizes the vascular tissue, causing plugging of the xylem and water stress. Wounds caused by feeding of root-knot nematodes are entry points for the bacteria into root tissue. Temperature is a major determinant in development of the disease, which is widespread in tropical, subtropical, and warm temperate regions, where the mean soil temperatures exceed 15°C.

**Symptoms and signs:** Initial symptoms on maturing ginger leaves appear as a downward and inward folding of the lamina followed by marginal chlorosis, necrosis, and wilt (Fig. 1). As leaves become necrotic, flagging occurs and the tips bend downward (Fig. 2). Upper leaves wilt first on hot days followed by recovery throughout the evening and early hours of the morning. Complete wilt occurs during high temperatures followed by death of the plant (Fig. 3). The disease progresses into the rhizome, where blackening of the pith and the cortex can be seen (Fig. 4).

**Survival:** The pathogen resides in soil and infectious populations may survive for several years. Continuous cropping of susceptible plants favors infection. Alternative weed hosts, such as the invasive Kahili wild ginger, can enhance survival of the pathogen between cropping seasons.

### Disease Management

Principal control measures are selection of pathogen-free rhizomes for seed pieces and storage of planting stocks under dry cool conditions, followed by planting into fields where the disease has not previously been observed. Hot-air treatments (50°C for 30 min) of ginger rhizomes may reduce inoculum in seed pieces. Whenever possible, new plantings should be started with tissue-cultured plants to ensure clean culture, followed by rhizome increase in bag culture. Other cultural practices include planting in cooler seasons, careful use of irrigation water to avoid contamination from diseased fields, and disinfestation of workers' shoes and machinery. It also may help to bury inoculum deeply by tilling or to reduce moisture and expose inoculum to the sun by repeated disk plowing of soil. Fallows of 18 months are used in India or shorter periods for dry soils. All rhizome tissue and weeds must be removed for an effective fallow. Rotation with maize or rice for 2 years or more reduces

disease incidence. Chemical control of bacterial wilt is generally not feasible, and resistant cultivars have not been reported for ginger.

## References

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Figure 1. Diseased plants with downward and inward folding of lamina, yellowing, and marginal necrosis of leaves. (Courtesy J. Nimmal/M. Paret)



Figure 2. Leaf roll and necrosis of leaves precede wilting and death of plant. (Courtesy J. Nimmal/M. Paret)



Figure 3. Devastated ginger field. (Courtesy A. Hayward)



Figure 4. Blackening of pith and cortex of rhizome. (Courtesy A. Alvarez)