Xanthomonas oryzae: Life cycle, symptoms and control measures

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Xanthomonas oryzae

- The genus *Xanthomonas*, which mostly comprises phytopathogenic bacteria, is a member of the family Xanthomonadaceae.
- Among xanthomonads, *Xanthomonas oryzae* pv. *oryzae* causes bacterial blight (BB) of rice which is one of the most important diseases of rice in most of the rice growing countries.
- **Rice bacterial blight**, also called **bacterial blight of rice**, deadly bacterial disease that is among the most destructive afflictions of cultivated rice (*Oryza sativa* and *O. glaberrima*).
- In severe epidemics, crop loss may be as high as 75 percent, and millions of hectares of rice are infected annually.
- The disease was first observed in 1884–85 in Kyushu, Japan, and the causal agent, the bacterium *Xanthomonas oryzae* pathovar *oryzae* (also referred to as *Xoo*), was identified in 1911, at that time having been named *Bacillus oryzae*.
- Thriving in warm, humid environments, bacterial blight has been observed in rice-growing regions of Asia, the western coast of Africa, Australia, Latin America, and the Caribbean.

Symptoms

- **Leaf blight:** Water-soaked to yellowish stripes on leaf blades or starting at leaf tips with a wavy margin.
- Leaves with undulated yellowish white or golden yellow marginal necrosis, drying of leaves back from tip and curling, leaving mid rib intact are the major symptoms.
- Appearance of bacterial ooze that looks like a milky or opaque dewdrop on young lesions early in the morning
- Severely infected leaves tend to dry quickly
- loss in grain yield may be up to 60%.
- **Seedling wilt or kresek:** Observed 1-3 weeks after transplanting
- Green water-soaked layer along the cut portion or leaf tip as early symptom
- Leaves wilt and roll up and become grayish green to yellow
- Entire plant wilt completely
- Infected seedlings usually are killed by bacterial blight within two to three weeks of being infected; adult plants may survive, though rice yield and quality are diminished.

Seedling wilt-Kresek

Leaves with wavy yellow marginal necrosis

Drying and curling of leaves leaving midrib intact

Affected leaves with wavy yellow marginal necrosis

Confirmation

- To distinguish kresek symptoms from stem borer damage, the lower end of the infected seedling can be squeezed between the fingers.
- Yellowish bacterial ooze may be seen coming out of the cut ends.
- The cut portion can be observed against the light to see the bacterial ooze streaming out from the cut ends into the water.
- After 1-2 hours, the water becomes turbid.

Bacterial Ooze

Disease cycle

- Rice plants become infected with *Xanthomonas oryzae* through rice seed, stem and roots that are left behind at harvest, as well as alternative weed hosts.
- *X. oryzae* lives on dead plants and seeds and probably moves plant-to-plant best through pattywater from irrigation or storms.
- Upon introduction to the host plant, the bacterium infiltrates the plant through natural openings (water pores and growth cracks on roots) and/or leaf and root wounds.
- *X. oryzae* grows in the plant and infects the plant's leaf veins as well as the xylem causing blockage and plant wilting.
- Bacteria oozes from leaf lesions and is spread by wind or rain, especially when strong storms occur and cause wounds to plants.
- *X. oryzae* has a wide host range that includes *Leersia sayanuka* and common grasses and weeds, which acts as alternative host for the bacterium and are considered the most important source of primary inoculums, as well as a great mechanism for bacterium survival.
- In nongrowing seasons, *Xoo* may survive in rice seeds, straw, other living hosts, water, or, for brief periods, soil.

Environment Conditions

- *Xanthomonas oryzae* is endemic to Japan, but can also be found throughout the tropical rice producing countries of Asia.
- In the tropics the pathogen has the highest level of incidence during the rainy season when rain and wind wound crops.
- Rain and infected pattywater are the main dispersers of the disease therefore fields found in low, wet areas with poor drainage and susceptibility to flooding are areas of high incidence.
- The presence of *Leersia sayanuka* is also key to the spread of disease because it is a naturally growing weed usually found around patties and has the ability to be infected by the bacterium and spread the bacterium through a rice patty.
- The use of nitrogenous fertilizer has shown an increase in incidence but mainly because there is more plant growth and conditions stay more humid, but does not have an effect on lesion size.
- During drier weather bacterial ooze will secrete from leaf lesions in hopes of finding a new host.
- Ideal temperatures for *X. oryzae* growth are 26–30 °C (79–86 °F); 20 °C (68 °F) being the best temperature for initial growth.
- *X. oryzae* can live in soil with pH range from 4–8.8; optimum pH being 6-6.50.

Management Strategies

- Methods of controlling rice bacterial blight are limited in effectiveness.
- Chemical control has been largely ineffective in minimizing bacterial blight because of safety concerns, practicality, and bacterial resistance.
- Biological control methods, which rely on the use of bacterial antagonists of pathogens (disease-causing organisms), can reduce bacterial blight, though their use has been limited.
- The most-common method of defending against rice bacterial blight is the cultivation of rice varieties with genes that confer resistance to *Xoo* infection.
- Over 30 resistance genes, termed *Xa1* to *Xa33*, have been identified in rice plants, and some, such as *Xa21*, have been integrated into the genomes of commercial rice strains.
- These resistant rice varieties have been largely successful, dramatically reducing yield losses in many rice-producing countries.
- For control in the field, use of seed from uninfected plants (or seed treatments), resistant varieties (as available) and careful attention to crop management (for example, by water control, avoidance of damage to seedlings) are most important.
- Awoderu et al. (1991) also place importance on restricting nitrogen fertilizer applications to about (80-100 kg N)/ha.