Chapter 7
Biological Control of Sheath-Rot and Other Fungal Diseases

Limited amount of research that is available on the biological control of sheath-rot (causal agent: *Sarocladium oryzae*), stem rot (causal agent: *Sclerotium oryzae*) and bakanae (causal agent: *Fusarium moniliforme*) is described in this chapter. These are minor diseases. However, the sheath-rot can be a constraint if it occurs in serious proportions as it causes discoloration of the sheath and affects the marketable quality of rice grains. Vasudevan, Kavitha, Priyadarisini, Babujee, and Gnanamanickam (2002) documented most of the work on the biological suppression of these diseases.

Sheath-Rot (Sh-R)

The only available records are from work that was carried out in the author's laboratory at the University of Madras in India and the International Rice Research Institute in the Philippines.

Sakthivel (1987) carried out detailed studies on sheath-rot suppression with *Pseudomonas fluorescens* strains. A *Pseudomonas fluorescens* strain antagonistic to *Sarocladium oryzae* the sheath rot (Sh-R) pathogen of rice in shown in Fig. 7.1.

The same Pfcp strain caused an inhibition of 2.5 cm (diameter) seen here (in plate on right) also caused in-planta reduction of 54% Sh-R incidence in IR20 rice when it was evaluated in a greenhouse test. Imprints of rice seedlings and a direct-observation technique of staining roots with fluorochromes confirmed the

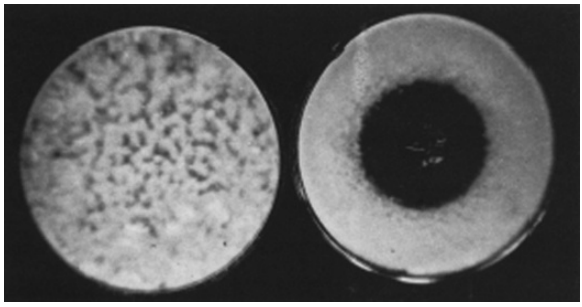

Fig. 7.1 Laboratory dual plate assay shows inhibition of *Sarocladium oryzae* by a *Pseudodmonas fluorescens* strain Pfcp isolated from citrus leaves (plate on the *right*). Plate on the *left* has the uninhibited growth of the pathogen in untreated control (Sakthivel, 1987)

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association of *P. fluorescens* with roots and the ability of the strain to move along shoot tips. In three field tests, treatment with *P. fluorescens* reduced the severity of Sh-R by 20–42% in five rice cultivars. Bacterization of rice cultivars with *P. fluorescens* also enhanced plant height, number of tillers, and grain yields from 3 to 160% (Sakthivel & Gnanamanickam, 1987).

At IRRI, Rosales, Vantomme, Swings, De Ley, and Mew (1993) identified a set of bacterial strains that were assembled from the rice rhizosphere as useful antagonists to different rice pathogens and in the process, identified also antagonists to *Sarocladium oryzae*. Sh-R fungus and its toxin, cerulenin, had unique interactions with other fungal pathogens of rice such as *Magnaporthe oryzae, Rhizoctonia solani, and Sclerotium oryzae*. The growth of these fungal pathogens was inhibited in laboratory tests. Therefore, in a greenhouse experiment, Gnanamanickam and Mew (1991) examined if these inhibitory interactions of *S. oryzae* with other fungal pathogens of rice contributed to dominance of Sh-R and the results suggested that this might be true. However, in the absence of adequate field observations, no further conclusions were arrived.

Sakthivel and his team of researchers at Pondicherry University and a research group in Tamil Nadu Agricultural University in southern India have remained active in elucidating the role of *Sarocladium oryzae* toxins (helvolic acid, cerulenin, and SO-1 toxin) for virulence towards rice in the induction of Sh-R disease symptoms including the discoloration of rice grains (Ghosh, Amudha, Jayachandran, & Sakthivel, 2002; Ayyadurai, Kirubakaran, Srisha, & Sakthivel, 2005; Nandakumar, Babu, Amutha, Raghuchander, & Samiyappan, 2007). While the current status of the disease and Sh-R control strategies has been reviewed, there is no further report on biological control (Sakthivel, 2001).

Stem Rot

Stem rot is also a minor disease of rice and has occurred in serious proportions in California rice. There has been only one study on the use of antagonistic strains of bacteria. They were used as seed treatments for the biological suppression of the stem-rot pathogen, *Sclerotium oryzae* (Elangovan & Gnanamanickam, 1993). Stem-rot infection was reduced by the bacteria treatments which also affected the number of the minute sclerotia of the pathogen formed. Rosales et al. (1993) identified *P. aeruginosa*, *B. subtilis* and *B. pumulus* strains that were effective against *Sclerotium oryzae*.

Bakanae

Biological control of this rice disease caused by *Fusarium moniliforme* has been studied by Mew and his team of researchers at IRRI. Seed treatment of rice with rice-associated antagonistic bacteria produced satisfactory reductions of bakanae symptoms (Rosales & Mew, 1997).

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