

Bakanae Disease of Rice in California – Update

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Bakanae is one of the oldest known diseases to infect rice in Asia, but it was not observed in the United States or California until 1999. Since its introduction, bakanae has spread to most of California's rice growing regions. Current losses due to bakanae in California are minor, but in Asia, losses of up to 70% have been reported. The extent to which bakanae could effect California rice production is currently unknown.

Causal Organism

Bakanae is caused by the fungus, *Fusarium moniliforme* Sheld, which is the anamorph of the ascomycete, *Gibberella fujikuroi* Saw. *Gibberella* is heterothallic, thus, both mating types must be present for the production of perithecia. The anamorph is the predominant stage found in the field, and has become widespread throughout the California rice production area. The teleomorph, (*Gibberella fujikuroi*) has only recently been observed in California rice fields.



Figure 1 – Early symptoms of bakanae infection.

Symptoms

While bakanae is generally thought of as a seedling disease it can be observed throughout the growing season. The earliest symptoms of bakanae are manifested roughly one month after planting (Fig 1). Infected seedlings appear to be taller, more

slender and slightly chlorotic when compared to healthy seedlings (Fig 2). The rapid elongation of infected plants is due to the production of Gibberellin, a plant hormone, by the fungus. Bakanae plants are often visible arching above the healthy rice plants (Figs 3 & 4). Healthy plants continue to grow, while bakanae plants usually begin to senesce, and eventually most infected plants are not visible above the healthy. As the season progresses, bakanae plants may die before reaching maturity, or if they do survive to heading, the panicles they produce are mostly empty (Figs 5 & 6). These classic symptoms, seedlings that rapidly elongate and then die without producing seed are where the disease gets its name, Bakanae, meaning 'foolish seedling'.

As the diseased plants senesce and die, mycelium of the fungus may emerge from the nodes (Fig 7), and sporulation of the pathogen may be easily visible above the water level (Fig 8 & 9). After the water is drained, the fungus sporulates profusely on the stems of diseased plants (Fig 10). This sporulation appears as a cottony mass (Fig 11) and serves to contaminate healthy seeds during harvest. When both mating types of the fungus are present, perithecia (the perfect stage) may form. Perithecia appear as dark blue flask shaped bodies on the nodes and stems of infected plants (Fig 12). Ascospores produced in perithecia may also contaminate seed and serve as inoculum the following season.

Bakanae Disease Cycle

The bakanae pathogen is known to over season as spores (both conidia and ascospores) on the coat of infested seeds. Since infected plants produce only empty panicles, there is no evidence of internal infection of seeds.

The fungus can over season in the soil and residue, and infection of non-infested seeds by spores in the soil has been demonstrated, although the length of time that spores can survive in the soil is unknown. It is likely that infested seeds are the most important source of inoculum, leading to both infected plants in the field and also introduction of the disease to non-infested fields.

Management of Bakanae

The most effective means of control for this disease is the use of non-infested seed, when possible. Also, when possible, in the fall, burn the residue of fields with known infection.

Current Research

Currently research is being conducted to:

- ❖ Determine the distribution of bakanae in California.
- ❖ Assess the potential of eliminating spores from infested seed using sodium hypochlorite seed treatments.
- ❖ Study the extent and role of soil inoculum in the disease cycle.
- ❖ Determine the variability of the pathogen population in California.
- ❖ Identify effective fungicide seed treatments.

Bakanae Update - Continued



Figure 2 - The bakanae plant (right) is taller, more slender and more chlorotic than the healthy.



Figure 3 - Bakanae plants visible, arching above the healthy plants.



Figure 4 - A closer look at young bakanae plants.



Figure 5



Figure 6

Figures 5 and 6 - Empty panicles produced as a result of bakanae infection.



Figure 7 - Mycelium emerging from the node of an infected plant.



Figure 10 - Cottony mass of sporulating mycelia



Figure 11 - Multiple stems with cottony masses of sporulation.



Figure 12 - Dark blue perithecia forming on infected plants.



Figure 8 - A typical late season bakanae plant, note the sporulation at water level and the empty panicles



Figure 9 - Masses of sporulation just above the water level