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Fungicide application timing to control stem rot and aggregate sheath spot of rice

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In 1920, Charles Chambliss, then agronomist in charge of rice investigations with the United States Department of Agriculture, wrote in the *Farmers' Bulletin 1141 - Rice Growing in California*, that "No diseases have been found to affect the rice crop of California." This disease-free period continued until the 1960s, when seed rot, seedling disease, and stem rot were recognized as problems that could affect the stand and yield of rice.

Since then, four diseases have become major constrains of rice production in California. Stem rot, aggregate sheath spot, blast, and kernel smut can be serious problems some years in some areas of the Sacramento Valley. Other diseases, such as bakanae and false smut, are uncommon. This might change in the future. For example, kernel smut was first detected in California in the mid 1980s, did not become widespread until the mid 2010s, and then became a major problem in the northern Sacramento Valley in 2018.

Stem rot (caused by *Sclerotium oryzae*) (fig. 1) and aggregate sheath spot (caused by *Rhizoctonia oryzae-sativae*) (fig. 2) are found at low levels in most rice fields. Before the ban on rice straw burning was put in place, burning was the main management tactic for these diseases. At the end of the season, these pathogens produce sclerotia (fig. 1), which are resting structures that allow them to survive in the field during the host-free period. Over time, as sclerotia accumulate in the field, the disease becomes more severe, resulting in dead leaves, lodging, panicle blanking, and yield reduction. Burning the straw eliminates the sclerotia and reduces the inoculum going back into the soil. In the late 1990s, the fungicide azoxystrobin was registered on rice for blast control. Subsequent trials have shown that this fungicide also has activity against stem rot and aggregate sheath spot. Currently, close to 50% of the rice acreage is treated with azoxystrobin.

A recurring question regarding the use of fungicides in rice is what the best timing of azoxystrobin application is. To control blast, the application should be done at the early heading stage, to protect the panicles from becoming infected. Treatments at this time also result in stem rot and aggregate sheath spot incidence and severity reduction. However, PCAs experiencing problems with stem rot or aggregate sheath spot wondered if, for those diseases, a better application timing might be the mid tillering stage (35 to 45 days after seeding). At mid tillering, the canopy has not completely closed, which would allow the fungicide to reach the tillers at the water line, where stem rot and aggregate sheath spot infections start. Additionally, most growers apply a clean-up herbicide at this time; tank mixing the fungicide with the herbicide would result in application cost savings. To determine the best timing of fungicide application for these two diseases, eighteen fungicide trials were conducted between 2017 and 2019 in several locations of the Sacramento Valley.

FIG. 1

FIG. 2

Figure 1. *Tiller affected by stem rot showing sclerotia forming inside*

Figure 2. *Tiller with aggregate sheath spot lesions*

Table 1. Average percentage disease severity reduction and number of trials (in parenthesis) conducted in the Sacramento Valley between 2017 and 2019.

Disease	Azoxystrobin at mid-tillering	Azoxystrobin at mid boot	Azoxystrobin at early heading
Stem rot	9 (9)	23 (4)	28 (13)
Aggregate sheath spot	21 (8)	76 (4)	57 (13)

The trials included registered and experimental products. In this article, we report results with azoxystrobin applied at 114.5 gr ai/a. Application timings tested were mid tillering, mid boot (4-inch panicle inside the boot), and early heading (when 20-50% of panicles have emerged from the boot). At draining, a 25-tiller sample was cut from each treatment plot and tillers evaluated for disease lesions. Disease severity was evaluated using a scale from 0 (no disease) to 4 (tiller rotted through for stem rot or lesions reaching the panicle for aggregate sheath spot).

Usually, one of the two diseases is more prevalent than the other, therefore, we only evaluated one disease per trial. In most stem rot trials, the incidence (the proportion of tillers showing disease lesions) of the disease was high, reaching 100% in one trial. Aggregate sheath spot incidence was more variable, with more than half the trials having an incidence larger than 25%. Severity of both diseases was variable, but overall, stem rot trials had a higher level of severity than stem rot.

Azoxystrobin reduced stem rot severity the most when applied during the early heading stage and the least when applied at mid-tillering (table 1). When applied at mid boot, the reduction was similar to when azoxystrobin was applied at early heading, however, only four trials included this application timing. When azoxystrobin was applied at mid-tillering, half the trials did not see any severity reduction (fig. 3).

Average reduction of aggregate sheath spot severity was highest when azoxystrobin was applied at the mid boot stage (table 1). Again, only four trials included this timing. When azoxystrobin was applied at the early heading timing, there was a lot of variability on the results; however, half the trials resulted in more than 70% severity reduction (fig. 3).

The trials showed that the best application timing to control stem rot with azoxystrobin is early heading. For aggregate sheath spot, mid boot seems to be the best timing; however, application at early heading provided good control for both diseases. The least effective timing for both diseases was mid-tillering. For those growers and PCAs that want to target smut and stem rot or aggregate sheath spot, application of fungicides controlling those diseases at the mid boot stage (the timing for smut) might be an option. ■

Figure. 3. Percentage reduction in stem rot (SR) aggregate sheath spot (AGSS) severity by application of azoxystrobin at three different timings. Boxes represent 50% of the data, and the whiskers represent the upper and lower 25% of the data. The line inside the boxes represents the median. The small dot represents an outlier.