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THE POSSIBLE ROLE OF PLANT PATHOGENS IN LOUISIANA'S BROWN MARSH SYNDROME

Raymond W. Schneider and Susan Useman, Department of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Center

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Approximately 158,000 hectares of *Spartina alterniflora* (smooth cordgrass), the predominant plant species in Louisiana's salt and brackish marsh, died in 2000-2001 from unknown causes. This rapid dieback occurred during a severe drought and unusually high summer temperatures. The term "brown marsh syndrome" (BMS) was coined to describe these large expanses of dead plants and bare mud flats (Fig. 1).

Mesocosms of three intact marsh soils with intact sods of *S. alterniflora* were established at the Center for Ecology and Environmental Technology of the University of Louisiana at Lafayette, LA, and treatments were imposed to simulate different salinity levels, tidal ranges, and rainfall. This experiment was directed by Dr. Robert Twilly in an investigation of the roles of abiotic factors in the brown marsh syndrome. We sampled roots and shoots when the experiment was disassembled with the intention of categorizing treatments with respect to fungal communities. In addition, representative strains would be used in pathogenicity tests to assess their potential for causing BMS. Approximately 80 fungal cultures were recovered, identified and classified according to genera. They were then grouped according to mesocosm treatment in preparation for conducting exhaustive pathogenicity tests. The predominant fungal genera were *Aspergillus* (about 90%), *Fusarium* (about 5%) and other genera that showed no correlation with any of the mesocosm treatments. *Aspergillus* species, with a few notable exceptions, are generally considered to be nonpathogenic, and this was the case in these studies. None is known to be pathogenic on roots or stems of other plant species. *Fusarium* species, however, are well known as pathogens, with some species being pathogenic on roots and stems of graminaceous hosts where they generally cause stalk rots (Fig. 2), diseases with symptoms very similar to those observed in BMS-affected sites. The taxonomy of this group is very difficult and in a constant state of flux. DNA sequence analyses suggest that strains from *S. alterniflora* are closely related to *F. verticillioides*, the corn and sorghum stalk rotting pathogen, but there are enough differences to place it in a group of its own. It is likely that these pathogens will be described as a new species.

There was surprisingly little species diversity within the population of root infecting fungi from the microcosm samplings. This applies across all the imposed environmental stressors and three collection sites. In addition, collections from other brown marsh sites had approximately the same abundance of species as the mesocosms. Apparently, the habitat is extremely restrictive with regard to fungal inhabitants, or the plant has developed a very high level of selection for root infecting fungi.

We were successful in demonstrating pathogenicity for *Fusarium* spp. that were isolated from the mesocosm collection and from collections from other sites (Figs. 3 and 4). In addition, a culture of *Rhizoctonia solani*, causal agent of sheath blight in rice, caused typical BMS symptoms (Fig. 5), although this fungus was not isolated from *S. alterniflora*. No other fungi were found to be pathogenic. We conclude that the range of potential stalk and root pathogens for *S. alterniflora* is very narrow. Furthermore, because *Fusarium* spp. are widespread and readily recovered from healthy-appearing plants, it is likely that, if pathogens played a role in the brown marsh syndrome, they required a predisposing stress event in order to become virulent. In fact, this fungus causes a leaf disease that we described as black leaf spot (Fig. 6), but the leaf disease is not severe and does not cause plant death. However, it is possible that the fungus can survive in association with the host plant in a benign manner, and when stress conditions prevail, this normally mild pathogen causes a severe stalk rot (BMS). This scenario is exactly equivalent to the stalk rots of corn and sorghum in which water and high temperature stressors are required for these otherwise weak pathogens to cause disease.

Additional experiments were conducted in which plants were exposed to different levels of drought and salinity in an attempt to determine if plants could be predisposed to infection as described above for stalk rots of corn and sorghum (Fig. 7). Results clearly indicated that the high temperatures and drought associated with the onset of BMS in Louisiana's marshes were sufficient to induce this otherwise weak pathogen to cause the marsh dieback.

Figure 1. Brown marsh syndrome in Louisiana's coastal marsh. Photo courtesy of Dr. Karen McKee, U. S. Geological Survey.

Figure 2. Symptoms of stalk rot of corn caused by *Fusarium verticillioides.* Photo courtesy of American Phytopathological Society.

Figure 3. Comparison of symptoms caused in *Spartina alterniflora* by strains of *Fusarium* sp.

Figure 4. Stem symptoms caused in *Spartina alterniflora* by strains of *Fusarium* sp.

Figure 5. Symptoms caused in *Spartina alterniflora* by *Rhizoctonia solani*, the sheath blight pathogen of rice.

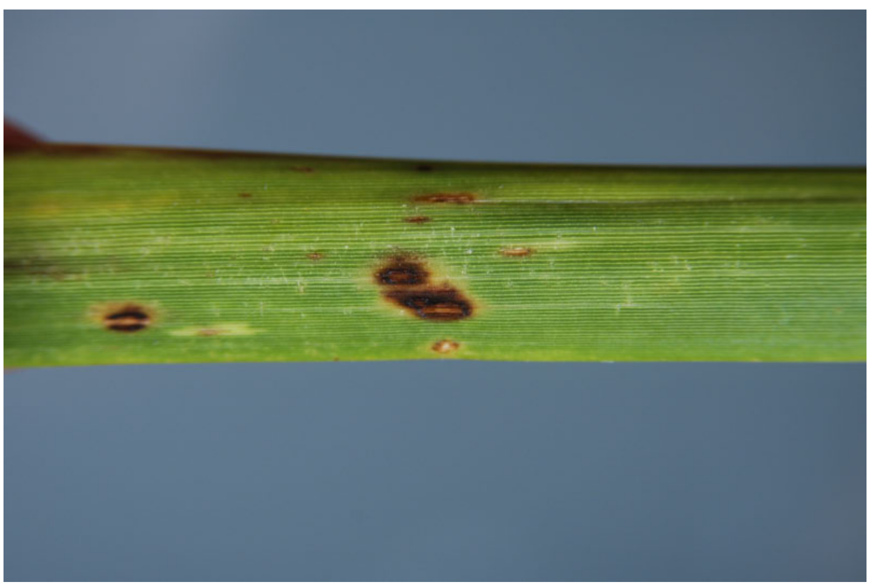

Figure 6. Black leaf spot of Spartina *alterniflora* caused by the same strains of *Fusarium* sp. associated with brown marsh syndrome.

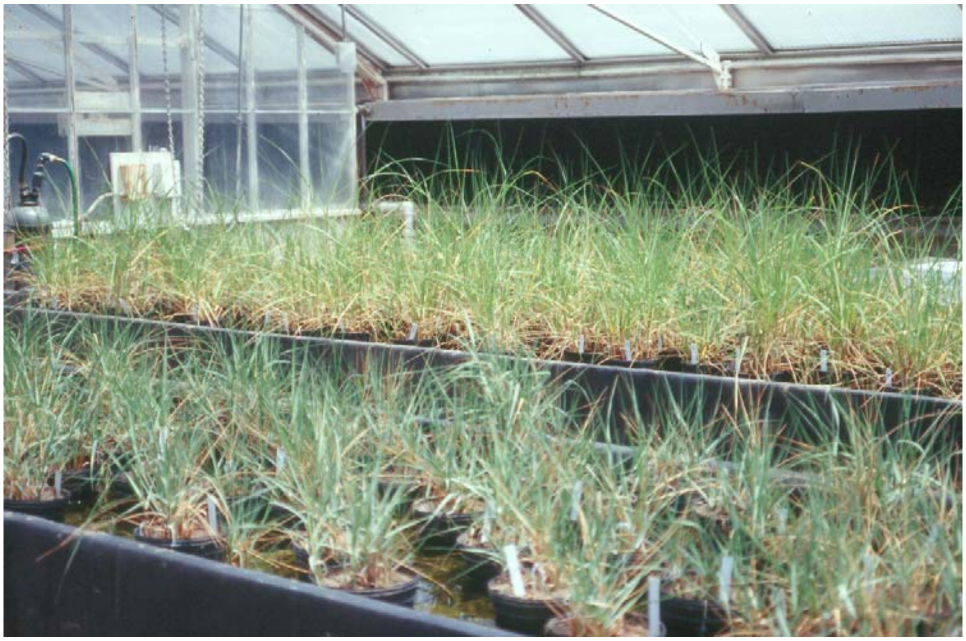

Figure 7. Overview of an interaction experiment in which *Spartina alterniflora* was exposed to different salinity levels, drought and several putative pathogens.