SEEDBORNE PATHOGENS AND THEIR ETIOLOGY

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Abstract

Seedborne pathogens are an important constraint to production in many crops. There are many pathogens and other microorganisms that are naturally associated with seed. The importance of limiting the presence of a specific microorganism on seed include yield or quality losses associated with the organism, the importance of seedborne inoculum to losses from the problem, and the feasibility and cost of producing seed free of that organism. For seedborne pathogens this is the disease control principle of exclusion, preventing the introduction of a pathogen to fields or regions where the pathogen does not occur. Bacterial fruit blotch of watermelon, caused by the bacterium *Axonopodis avenae* subsp. *citrulli*, a recently introduced pathogen that can cause 40 to 90% yield loss demonstrates the value and strategies for controlling seedborne inoculum of a pathogen. A widespread epidemic of bacterial fruit blotch developed in 1989 and was associated with contaminated seed, resulting in lawsuits against seed companies and seed companies' requiring growers to sign seed agreements limiting liability. Since the pathogen has limited ability to survive in fields, the problem was eliminated by producing seed free of the pathogen. Cleaning up the seed supply involved moving seed production to a region with an environment not conducive for the pathogen, producing seed in fields that had not been in melon production for 3 years, inspecting production fields to assure that the disease did not occur in the field, and assaying seed to assure that the level of contamination was less than 1 in 10,000 seed for a seed lot. Finally disinfestation or disinfection techniques were evaluate to further reduce contamination. This example demonstrates the impact elimination of seedborne inoculum can have on an important disease, with the most effective strategy being not using fields that have the disease for seed production and then validating that seed is pathogen-free. Looking at the numerous pathogens on cottonseed, I will highlight two pathogens where seedborne inoculum is of importance for cotton production. Bacterial blight of cotton caused by *Xanthomonas citri* subsp. *malvacearum*, a disease first reported in 1891, was common in the 1950s to 1970s in the United States but was eliminated from California, the Mid-south and the Southeast through acid-delinting of seed, which greatly reduced the likelihood of seed contamination, and moving seed production. However, recent outbreaks of the disease in the Mid-south and Southeast has raised concerns over the current source of the inoculum and strategies to limit bacterial blight. Like the bacterial fruit blotch pathogen, the bacterial blight pathogen on cotton is limited to survival on cotton residue left on the surface and seed. Survival of inoculum can result in disease in the following cotton crop based on research, but no long-term survival has been demonstrated. Studies with the same species on citrus have shown spread is limited to about 580 meters (1900 feet) over a 30-day-period, suggesting long-distance spread is not important. Thus exclusion becomes a critical disease control strategy for this disease. Acid-delinted seed has been shown in some studies to carry up to 3.9% infected seed, with the level of transmission sufficient for an epidemic being about 1 infected seed in 5000 seed. Just like bacterial fruit blotch, assuring seed production fields are free of the disease is critical since the level of seed testing required may be not feasible or economical and there is little likelihood that a seed treatment will clean up seed to the required stringency. Like bacterial fruit blotch, seedborne inoculum can result in an epidemic impacting the current crop as a result of the rapid spread and reproduction of bacterial pathogens. With bacterial blight of cotton, there are resistance genes available that have been used in a number of countries to further limit or eliminate this disease. Another seedborne pathogen that is of current concern on cotton are specific biotypes of *Fusarium oxysporum* f. sp. *vasinfectum*. Unlike the bacterial blight pathogen, the Fusarium wilt pathogen is long lived in soil and is common suggesting the seedborne nature of this pathogen should not impact the disease epidemic. However, in recent year's unique biotypes of *F. oxysporum* f. sp. *vasinfectum* in Australia and the identification of Race 4 in California has emphasized the importance of the seedborne nature of this pathogen. With Fusarium wilt, unlike bacterial blight, the concern is not the epidemic that will occur in the year when infected seed is planted but the slow buildup of disease over seasons to damaging levels, with populations of the pathogen persisting indefinitely. Disease control by cleaning up the seed supply can be successful to limit the pathogen by producing seed in fields or farms known to be free of these unique biotypes and scouting fields for Fusarium wilt symptoms to verify the field is free of disease. The goal is to limit the spread of these unique biotypes while resistance is developed in commercial cultivars. Other options that would be less successful are to verify seed lots are pathogen free or treating seed to reduce seed infection. Seed continues to be a major mechanism of dissemination of some pathogens. The recent resurgence of specific seedborne pathogens or unique biotypes of pathogens has emphasized the continued need for good stewardship of planting seed to optimize yields and avoid additional inputs for producers.