

Relationship Between Charcoal Rot, The Stay-Green Trait, and Irrigation in Grain Sorghum

Mandy G. Burgess¹, C.M. Rush¹, G. Piccinni², G. Schuster³

¹ Texas Agricultural Experiment Station, Bushland, Texas 79012

² Texas A&M Research and Extension Center, Uvalde, Texas 78801

³ West Texas A&M University, Canyon, Texas 79016

Abstract

Charcoal rot of grain sorghum, caused by *Macrophomina phaseolina*, is an important problem in the Southern United States, Mexico, and Africa. Drought stress and the stay-green gene have been reported to have a great impact on disease development. A field study was conducted in the summer of 2000 in Uvalde and Bushland, Texas by planting two near-isogenic cultivars differing in presence of the stay-green gene and applying four different irrigation treatments. The irrigation treatments used were 100% Potential Evapotranspiration (PET), 75% PET, 50% PET, and a limited treatment which was 50% PET until anthesis and then 100% PET during grain fill. Plants were inoculated with *M. phaseolina* infested toothpicks at heading. The stalks were split and the disease lesion and head weight were measured for individual plants. The inoculated plants exhibited lesions 54% longer than the control plants. The non stay-green cultivar in the lower irrigation treatments exhibited longer lesions suggesting higher disease incidence. The stay-green trait appears to have some resistance to charcoal rot because the lesions in the stay-green cultivar were about 27% shorter than the non stay-green line. These results suggest that the occurrence of charcoal rot can be greatly affected by irrigation and the stay-green gene.

Objectives

Macrophomina phaseolina invade plant tissue from the crown up and cause discoloration in the pith. The pith eventually disintegrates leaving only the vascular strands in tact. Numerous, small, black sclerotia form on these strands and are easily visible when stalks are split open. The most characteristic outward symptom of the disease is lodging. This often occurs in the driest part of the field. Other yield depleting factors associated with lodging are poor grain filling and premature ripening. In addition to lodging,

bleaching of outer stalk tissue may also occur. Cultivars containing the stay green trait have exhibited some resistance to charcoal rot. It is unsure whether or not the trait itself provides resistance to the disease or just tolerance to drought conditions. This study was designed to meet the following objectives: evaluate how irrigation management impacts disease development in a stay-green and non-stay-green hybrid and to quantify the effects of cultivar tolerance and irrigation on disease incidence, yield, and total profitability of the treatment combinations.

Materials and Methods

The charcoal rot study took place at two locations, Uvalde and Bushland, Texas. The objective of the study is to determine how the pathogen *Macrophomina phaseolina* affects sorghum crops in different irrigation treatments. Six cultivars, five stay-green and one non stay-green hybrid were used in the study. Four irrigation treatments were used in the study as well. The irrigation treatments include 100%, 75%, 50%, and 50/100% PET. The 50/100% PET treatment was irrigated at 50% PET until inoculation and 100% through remainder of the study. All six cultivars were grown in each irrigation treatment and there were four replications at each location. The plants in each combination were inoculated with *Macrophomina phaseolina* infested toothpicks two weeks prior to heading and plants inoculated with sterile toothpicks served as controls. Following inoculation and until harvest, plant leaf samples were collected from various treatments to quantify, by psychrometry, the severity of plant stress. Whole plants were collected periodically to measure disease development. A final disease rating was made at harvest by splitting the stalks open and measuring the lesion caused by the disease. Grain yield and total plant biomass were also recorded in both the inoculated and healthy plants and will be analyzed for a final report.

Conclusions and Future Research

The results gained from this study suggest that there is an interaction between irrigation, stay green, and the occurrence of charcoal rot. Because of the higher temperatures, we were expecting the disease incidence to be higher in Uvalde. The results do show a higher occurrence of charcoal rot in

the Uvalde study. Most of the lesions stayed below three centimeters in the Bushland study indicating less disease. We chose five different commercial stay green varieties because we wanted to observe just how well each line performed. This study will be repeated one more season in both locations. We are also planning a greenhouse study so that the conditions can be more controlled. In the greenhouse, we would like to try different inoculation methods as well as continue with the different water treatments. The yield data from this year is being analyzed and will be included in a future report.

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