INCIDENCE OF COTTON LEAF ROLL DWARF VIRUS (CLRDV) SYMPTOMS IN THE US COTTON BELT DURING THE 2020 GROWING SEASON

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Abstract

Cotton Leaf Roll Dwarf Virus (CLRDV), an aphid-transmitted *Polerovirus,* is the causal agent of cotton leafroll dwarf disease (CLRDD), an emergent threat to the US cotton industry. CLRDV, which has been reported to cause yield loss up to 80% on susceptible cultivars in Brazil, has only recently been detected in U.S. cotton during the 2017 growing season in Alabama. By the conclusion of the 2019 growing season, however, CLRDV was confirmed infecting cotton throughout the U.S. cotton belt. However, CLRDD yield impact remain difficult to assess. The overarching goal of this work was to assess the distribution of CLRDV in the cotton belt and to better understand its symptomology in different cultivars under diverse environmental conditions. To this end, Sentinel plots were planted during the 2020 growing season in AL, FL, GA, SC, NC, VA, MS, AR, LA, TN, and TX. To increase disease pressure, sentinel plot establishment was delayed relative to local recommendations in each location, between May 6th and June 21st. In addition, AL, AR, and TX trials included two planting dates as an effort to assess environmental effects on disease presence and symptom development. Each planting date was arranged in a randomized complete block design with four replications. Visual assessments of disease incidence were taken based on proportion of plants displaying characteristic CLRDD symptoms. Furthermore, a composite leaf sample was collected from every plot in all locations during cotton reproductive stages, late-August to mid-September, for CLRDV detection. The presence of CLRDV was assessed by the Plant Diagnostic Lab at Auburn University with a nested-PCR assay targeting the P0 open reading frame. Laboratory testing and formal statistical comparisons are underway. However, CLRDD symptoms were observed in all locations and cultivars. Most common symptoms included leaf rugosity, leaf drooping, bronzing of upper-canopy leaves, and increased vegetative growth with small leaves on plant apex.

Introduction

The cotton leaf roll dwarf virus (CLRDV) is an emergent pathogen in the US cotton belt and may threaten cotton production in this region. CLRDV, the causal agent of cotton leafroll dwarf disease (CLRDD), was found confirmed in symptomatic cotton plants in Alabama in 2017. Following its first report in 2017, CLRDV has since been detected in all cotton belt states. In Brazil, yield losses up to 80% have been documented when severe epidemics occurred. Even though genetic resistance exists for the typical and atypical CLRDV strains in commercial cultivars from Argentina and Brazil, the CLRDV strains found in the US have overcome known R-gene mediated resistance. In the US, yield losses assessments and forecast are still underway. A diverse set of symptoms associated with CLRDV-infected plants include leaf bronzing, intense reddening of main stem and petiole, leaf rugosity, leaf cupping, leaf tenting or drooping, accentuated verticality, and abnormal vegetative growth in the upper canopy are the most common. Furthermore, empirical observations appear to indicate certain symptoms to be more common in certain cotton production areas but not in others. In addition, cultivar also may affect CLRDD symptom expression. Together, these factors make this disease assessments and resistance screening laborious and difficult. Therefore, the overarching goal of this project is to understand CLRDD symptom expression and potential impact of environment and cultivar.

Materials and methods

Cotton Cultivars

The upland cotton cultivars PhytoGen (PHY) 480 W3FE, Deltapine (DP) 1646 B2XF, EXP 1 B3XF, and DynaGro (DG) 3615 B3FX were planted at recommended seeding rates at all locations. Previous empirical observations have found these cultivars to be susceptible and to express the most commonly seen CLRDV associated symptoms.

Field Experiments

The selected cultivars were planted in a randomized complete block design. Experiments were conducted at Brewton, AL; Jay, FL; Quincy, FL; Tifton, GA; Blackville, SC; Jackson Springs, NC; Suffolk, VA; Jackson, TN; Marianna, AR, Stoneville, MS; Winnsboro, LA; and College Station, TX. Planting dates varied from May 6th to June 21st. Approximately 90 days after planting, visual assessments were conducted in all locations for the incidence of symptoms associated with CLRDV. The percentage of plants displaying leaf bronzing, intense reddening of main stem and petiole, leaf rugosity, leaf cupping, leaf tenting, accentuated verticality, abnormal vegetative growth, stunting, zig-zag growth pattern, and node stacking were noted.

Results and Discussion

During the 2020 growing seasons CLRDD symptoms were observed in all experimental locations, except Jackson, TN. Overall, the most observed symptoms were reddening of main stem and petioles, tenting of leaves, leaf bronzing, and leaf rugosity (**Figure 1**). CLRDD symptoms appear to be, to an extent, expressed more commonly in some locations than others. For example, reddening of main stem and petiole was found in higher incidence in sentinel plots located in mid-south states and North Carolina when compared to other south-east states and Texas. Another clear example is bronzing very high incidence in North Carolina, while having much milder incidence in all other states. Despite the apparent prevalence of certain symptoms on certain locations, most CLRDD symptoms can be found, at least in very low level, is most locations with the disease. The variability in disease pressure across locations coupled with the predominance of certain symptoms in some locations but not in others, make cultivar performance generalizations difficult. However, in most cases, DynaGro 3615 and PhytoGen 480 lines presented either similar or higher symptom incidence than Deltapine 1646 or EXP 1 lines.

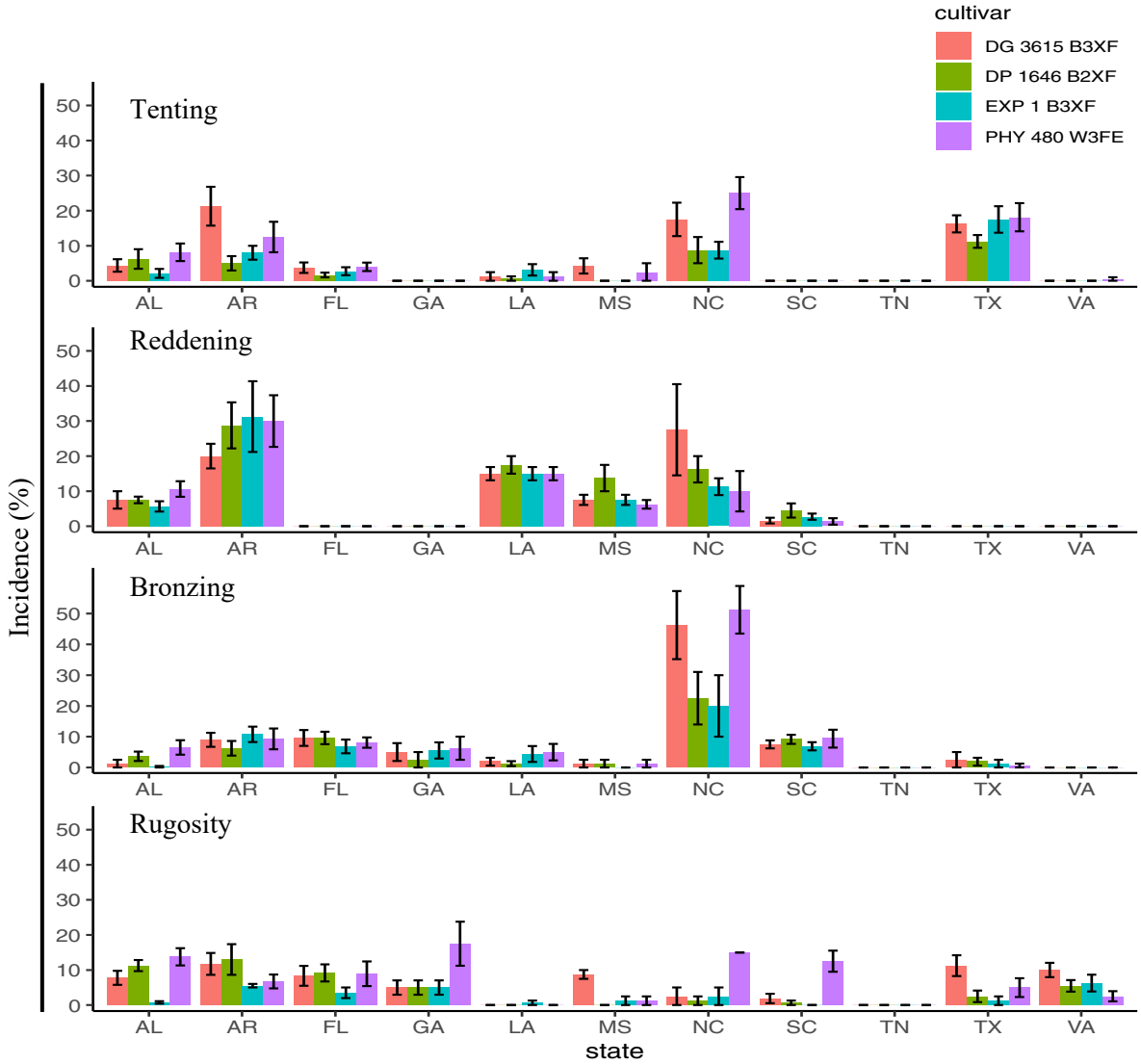

Figure 1. Incidence of CLRDD symptoms on four cultivars grown on eleven cotton belt states.

The diverse set of symptoms associated with CLRDD in the US make its visual quantification for epidemiological studies and resistance screening difficult. Our data show that the amount of disease was contingent upon which CLRDD symptom(s) are expressed. In extreme cases, if a symptom is ignored, a location may appear to be free of disease or a cultivar may appear to display resistance when in fact it is not the case. Therefore, visual disease

assessments must take in consideration all symptoms associated with CLRDD. For CLRDV detection, PCR assays are the gold standard and should be used when possible. Despite its availability, PCR assays are still expensive and laborious at large scale-experiments. Furthermore, the detection CLRDV in a field or experimental unit does not tell a complete story and should be matched with diseases quantifications, despite its difficulties. At this point, the genetic and environmental factors affecting CLRDD symptom development are not clear. However, the apparent differences of disease measures for cultivar and location seem to indicate that a likely GxE interaction affecting disease development and its symptom expression. It also may be relevant to keep in mind how these factors may also influence cotton aphid survival, population dynamics, and field infestation. Altogether, cultivar differences for disease development is a positive outcome, for it suggests the presence of genetic factors that can be manipulated by breeders for the production of cotton lines with increased field resistance to CLRDD. We intend to continue the sentinel-plots project in the 2021 growing seasons to gather more data with the objective of identifying factors environmental factors influencing CLRDD symptom development.

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