Potential of Brown MidRib (BMR – *bmr12*) Sorghum in Managing of Sugarcane Aphid

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Introduction

Sorghum is a globally significant crop known for its adaptability to diverse growing regions and its importance as a source of food and feed. However, its productivity is often threatened by insect pests such as the sugarcane aphid (*Melanaphis sacchari*), which can negatively impact plant physiology and significantly reduce yield anywhere from 10-70% (Vasquez et al., 2025a). Sorghum defends itself against insect pests through both direct and indirect mechanisms, including physical defenses and chemical defenses (Kundu et al., 2023).

The Brown Midrib (BMR) sorghum variant is characterized by its reduced lignin content and was originally developed to improve digestibility for livestock; however, the effect of BMR on insect pest management is not well understood. The project described herein examines how the BMR trait, specifically *bmr12*, influences plant defense mechanisms, growth, and how these changes affect the sugarcane aphid's ability to reproduce and colonize the host plant (Grover et al., 2024).

Purpose

The purpose of the study was to determine how the BMR trait alters plant physiology and defense mechanisms and how these changes impact pest management against the sugarcane aphid.

Methods

Experiments were conducted in a controlled greenhouse environment at the Harry R. Rosen Alternative Pest Control Center at the University of Arkansas in Fayetteville, Arkansas. The plants were grown under a photoperiod of 16-h-light/8-h-dark at 28 °C and 50-60% relative humidity. The three sorghum lines, RTx430 (wild-type), *bmr12*, and *11a*, were at the 5-leaf stage, with the exception for plants used in the aphid count experiment which were at the 7-leaf stage.

Plants were monitored for growth traits, physiological traits, physical defense traits, chemical defense traits, and aphid colonization. Aphid infestations were standardized by placing ten *Melanaphis sacchari* individuals on each plant and allowing them to reproduce. The total number of aphids was recorded after ten days to evaluate reproductive and colonization success.

Root morphology traits (root length, surface area, and volume) were analyzed using digital imaging software (WinRHIZO, Regent Instruments) (Gautam et al., 2024). Physiological parameters (net photosynthesis, stomatal conductance, transpiration rate, intercellular CO2) were analyzed using LI-COR (LI-COR Biosciences) (Gautam et al., 2024). Epicuticular wax was conducted by first recording the weight of an Eppendorf tube, followed by hole punching fresh

sorghum leaves (8 leaf discs per tube), and then placing 1mL of chloroform in the tube. The tubes were then vortexed and placed outside for 24 hours, allowing the chloroform to evaporate. The leaf material was removed, leaving the wax on the sides of the tube, and the tubes were weighed again to calculate the amount of wax remaining after evaporation (Vasquez, 2025b). Headspace volatile collections were conducted using 6 Vacuum Clar Air Delivery System units, each attached via polyethylene tubing to a glass dome (Gandham et al., 2025).

Results

The three sorghum genotypes exhibited differential differences in both growth and defense characteristics. The *bmr12* sorghum showed delayed germination, but no difference in growth or physiological traits compared to RTx430 and *11a*. Despite this delayed germination, aphid colonization was nearly 50% lower on *bmr12* plants compared to the control after 10 days.

In complement to this, epicuticular wax induction via sugarcane aphid feeding was higher in *bmr12* plants compared to RTx430 and *11a.* VOC analysis indicated that *bmr12* plants released higher levels of defensive volatiles, suggesting that the reduction in lignin indirectly enhances chemical defenses against herbivores. Additionally, *bmr12* plants demonstrated higher (albeit not significant) root branching and surface area, which may improve water uptake and help the plant recover more effectively after aphid feeding.

Implications

The *bmr12* sorghum genotype exhibits delayed germination, which may limit its initial access to essential resources. Additionally, 10 days of aphid feeding can interfere with the plant's normal physiological processes, affecting growth and overall health. Despite these challenges, *bmr12* appears to be better adapted to mitigating sorghum aphid attacks, showing nearly a 50% reduction in aphid colonization compared to the control, which is in line with the results found by Grover et al., (2024). This enhanced resistance is likely due to stronger indirect defense mechanisms through increased emission of volatile organic compounds (VOCs), although aphid activity may partially suppress these emissions. Furthermore, the greater fork number observed in *bmr12* plants suggests improved water use efficiency, which may contribute to their resilience under stress conditions caused by aphid infestation.

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