EVALUATION OF COMMERCIAL SORGHUM HYBRIDS FOR RESISTANCE TO *MELANAPHIS SACCHARI* (SUGARCANE APHID)

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Abstract

During the 2015 and 2016 seasons through field and growth chamber studies, grain sorghum, *Sorghum bicolor,* was evaluated for resistance to sugarcane aphid, *Melanaphis sacchari* (Zehntner), at three locations in Louisiana. Hybrids included a known resistant ATx2752/RTx2783, a known susceptible ATx2752/RTx430, and 14 hybrids with suspected resistance. The objective of this study was to determine the degree of resistance among the hybrids. The field study was a split-plot design with hybrids being the main plot. One sub-plot was protected from aphid infestation by means of an insecticide, sulfoxaflor (Transform) or flupyradifurone (Sivanto), while the other was left untreated. In addition to the field study, a seedling susceptibility screening was conducted with the same hybrids in a growth chamber. Hybrids were planted in 8-inch pots, with five seedlings per pot. At the 2 to 3 leaf stage, seedlings were infested with ~50 aphids per plant. Each plot was rated on a 1-9 injury scale at 17 days after infestation. In field trials, under light to moderate aphid pressure, hybrids that appeared susceptible (demonstrated a yield benefit from insecticide applications) included: ATx2752/RTx430 and DG M756B39. Hybrids that exhibited possible tolerance (high aphid days but no yield benefit from spraying included: DG M77GB52, DG 765B, and R94153. Hybrids that exhibited possible antibiosis (low aphid days and no benefit from insecticide applications included: ATx2752/RTx2783, R84353, R9813, SP6929, SP73B12, SP7715, SPX760, SP78M30, P-83P17, W-844-E, and DKS37-07. Additionally, ATx2752/RTx2783, DKS37-07, R9813, R84353, SP7715, SPX17414, SPX17514, NKX760 and W-844-E exhibited significantly less aphid feeding injury than ATx2752/RTx430 in the seedling susceptibility screening.

Introduction

The sugarcane aphid (SCA) *Melanaphis sacchari* (Zehntner) (Hemiptera: Aphididae) is a new pest of grain sorghum (*Sorghum bicolor*) in Louisiana since 2013. This species is somewhat cosmopolitan, distributed throughout tropical and subtropical regions of the world on hosts in the genera including *Pennisetum, saccharum,* and *Sorghum*. (Blackman and Eastop 2000).

Feeding symptoms of the SCA are manifested as reddening or purpling of leaf tissue and result in subsequent necrosis. Severe injury to seedlings can kill plants and reduce stand early in the growing season. Injury to pre-boot sorghum can sterilize or delay seed head development. This becomes a problem later in the season, when heading becomes inconsistent, which often results in problems with sorghum midge management when sorghum begins to flower. Injury to soft or hard dough sorghum can result in reduced test weight. High SCA numbers can also cause issues with harvest efficiency, resulting in machine failure and further jeopardizing yield potential.

Managing the sugarcane aphid requires a fully integrated approach; landscape management, timely planting, insecticide seed treatments, effective and timely scouting and treatment decisions, insecticide choice and efficacy, biological control, and selection of resistant grain sorghum hybrids. However little is known about the availability of commercial sorghum hybrids that offer the resistance to the SCA. The objective of this study was to evaluate commercial hybrids for their ability to tolerate aphid injury and to express antibiotic effects to SCA.

Methods

Grain sorghum entries with standard insecticide, fungicide and safener (Concep) seed treatments were planted in May to early June (LSU AgCenter recommended planting interval) at the Macon Ridge (Winnsboro, LA), Dean Lee (Alexandria, LA) and Northeast Research Stations (St. Joseph, LA). The tests were planted using a 4-row cone planter and the seeding rate was 75,000 seeds per acre. Plots were 8 rows x 40-50 ft. in length and 38-40 inch row spacing. The tests were split-plot design with 4 replicates. Thus split plots were 4 rows each. Plots were dryland or irrigated as needed using furrow irrigation. The split plots were a non-treated and a treated half. The treated half was sprayed with sulfoxaflor (Transform) at 1.5 oz/ac or flupyradifurone (Sivanto) at 4 fl-oz./ac as needed to prevent significant aphid infestation. The action threshold for triggering an aphid spray was based on the first detection of colonizing SCA. We solicited grain sorghum hybrids from a number of seed sources. We included a positive and a negative check. The positive check was a known resistant/tolerant hybrid (ATx2752/RTx2783 in 2015 & DeKalb 3707 in 2016), and the negative check was a known susceptible (ATx2752/RTx430 in 2015 & Dyna-Gro M75GB39 in 2016). We relied on natural aphid infestation for data collection. Plots were monitored weekly for aphid colonization, once colonization was detected, data collection proceeded weekly for the duration of the infestation. Aphid infestations were estimated in each split-plot by counting the number of aphids from 10 upper canopy (flag leaf is emerged) and 10 lower canopy leaves. Cumulative aphid days were calculated by site for each variety × spray combination by averaging the upper and lower leaf aphid populations (Ruppel et al. 1993). Additionally, once aphid infestations subsided, injury ratings were conducted. Plant injury was scored on a 1-9 scale where 1 = no injury and 9 = dead plant (Webster & Starks, 1984). All other economically important insects were controlled for the duration of the study. Furthermore, a fungicide application was applied at boot to prevent anthracnose infection. Once physiological maturity was reached, the entire test area was treated with glyphosate to facilitate desiccation and increase harvest efficiency. The middle two rows of each split plot were harvested using a 2 row plot combine at target 15-17% moisture. Yields were adjusted to 14% moisture. All data was analyzed using PROC GLIMMIX (PROC GLIMMIX SAS Institute Inc. 2011). Data was analyzed across test sites using the random effects of Site, Rep (site) and Hybrid*Rep (Site). Where significant interactions were detected between variety and spray, the SLICEDIFF option of the LSMEANS statement was utilized to determine if a given variety differed, sprayed vs. non-sprayed for difference in aphid days, injury and yield.

In the seedling susceptibility screening, hybrids were planted in 8-inch pots, with five seedlings per pot. Pots were kept in a climatic chamber at 27°C ± 1°C with 70% relative humidity and a 12:12 L:D configuration. When seedlings reached the 2-3 leaf stage, plants were manually infested with approximately 50 aphids per plant. Each plant was rated on a 1-9 injury scale where 1= no injury and 9= dead plant (Webster & Starks, 1984), 17 days after infestation. Data was analyzed using an ANOVA means separation with a protected LSD, $\alpha=0.05$.

Results

In the 2015 field trial, hybrids were determined to be susceptible to aphid colonization, benefiting in a reduction in aphid days where sulfoxaflor applications were made. These hybrids included; ATx2752/RTx430, DG M75GB39, DG 765B, and DG M77GB52. The remaining hybrids appeared to exhibit possible antibiosis, with cumulative aphid days being no different in sprayed vs. non-sprayed plots, these hybrids include; ATx2752/RTx2783, R84353, R9813, SP6929, SP73B12, SP7715, SPX760, SP78M30, P-83P17, W-844-E, and DKS 37-07 (Figure 1).

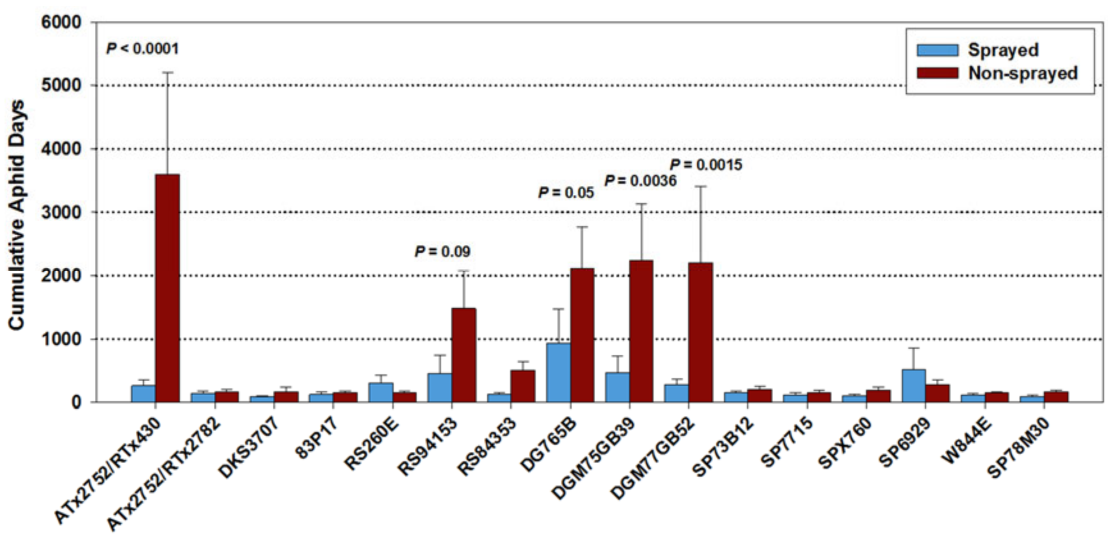

Figure 1. Cumulative aphid days of 16 grain sorghum hybrids treated for SCA or left non-treated, across three locations in Louisiana in 2015.

In 2016, seven of these hybrids were repeated with the addition of REV 9782. Hybrids that appeared to be susceptible in 2016 include; DG M75GB39, DG M77GB52, DG 765B, and REV 9782. Hybrids that experienced low aphid days in both sprayed and non-sprayed plots include; DKS 37-07, P83P17, W-844-E, and SP7715 (Figure 2).

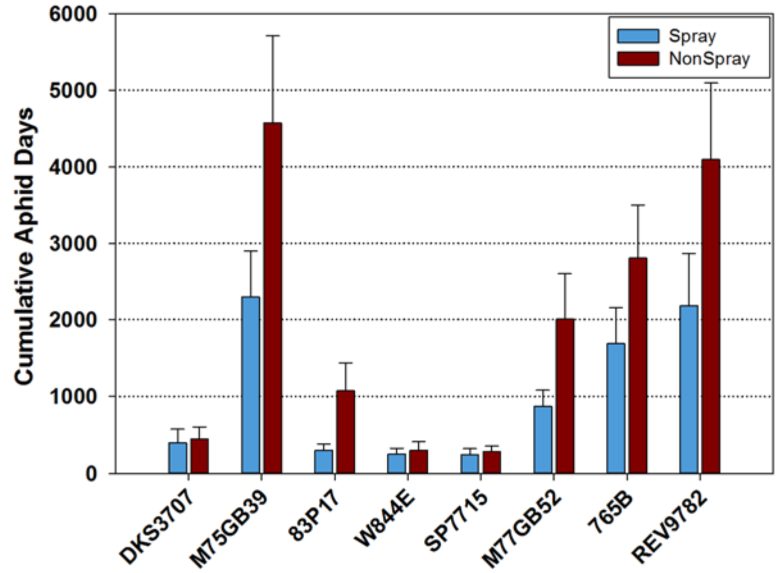

Figure 2. Cumulative aphid days of 8 grain sorghum hybrids treated for SCA or left non-treated, across three locations in Louisiana in 2016.

Yield data for 2015 revealed increased yields for certain hybrids where sulfoxaflor applications were made. These hybrids include; ATx2752/RTx430 and M75GB39 (Figure 3). Other hybrids that showed a decrease in aphid days where sulfoxaflor applications were made, did not show increased yield (765B and M77GB52), this suggests that these hybrids may be able to tolerate high aphid numbers without suffering yield reduction. Hybrids that appeared to offer resistance, did not show increased yields where insecticide applications were made, these hybrids include; ATx2752/RTx2783, R84353, R9813, SP6929, SP73B12, SP7715, SPX760, SP78M30, P-83P17, W-844-E, and DKS 37-07.

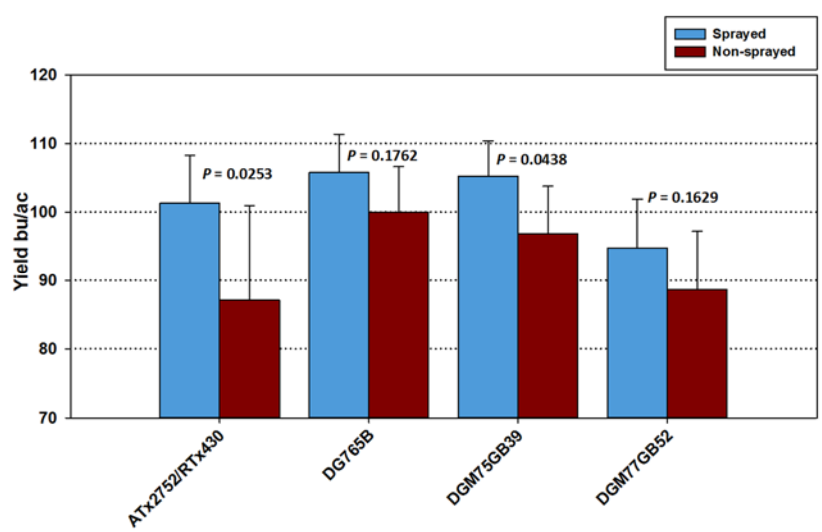

Figure 3. Yield in bu/ac of grain sorghum hybrids that experienced increased yields where insecticide applications were made in 2015.

In 2016, a yield benefit from insecticide applications was not detected in any of the hybrids tested at the three locations. Two locations experienced low aphid populations, while the other was jeopardized by late sampling. At the Dean Lee

Research Station in Alexandria, LA, pre-counts were taken when aphid numbers had reached greater than 2,000 aphids per leaf in the susceptible hybrids, and several hundred aphids per leaf in hybrids that appeared to offer resistance in previous evaluations (Figure 4).

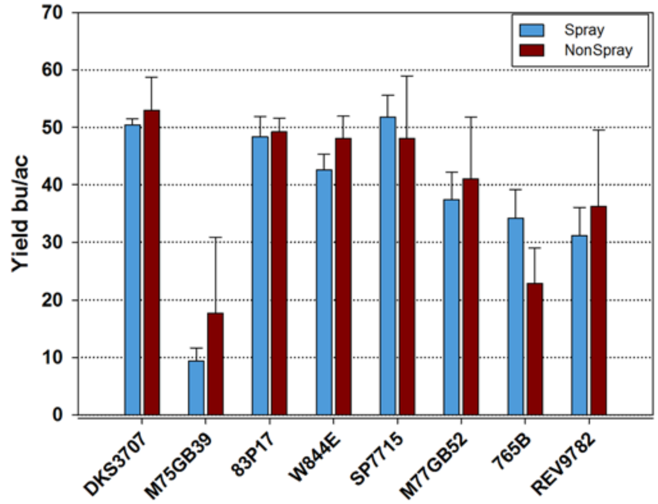

Figure 4. Yield in bu/ac of 8 grain sorghum hybrids at the Dean Lee Research Station in 2016.

In the seedling growth chamber screen, aphid feeding injury was rated on a 1-9 scale, a rating of 6 was used as our criteria for tolerance, at a rating of 6 and below, plants were considered healthier and capable of continued maturation after feeding injury. Hybrids that showed significantly less feeding injury than the susceptible hybrids were; ATx2752/RTx2783, DKS37-07, R9813, R84353, SP7715, SP73B12, SPX760, SP78M30 and W-844-E (Figure 5). There were hybrids that appeared to offer resistance in the field evaluation and the seedling screening. These hybrids include: ATx2752/RTx2783, R84353, R9813, SP6929, SP73B12, SP7715, SPX760, SP78M30, W-844-E, and DKS 37-07. P-83P17 appeared to offer resistance in the field evaluation, however in the seedling screening it appeared to be highly susceptible to SCA feeding injury, showing no differences from the known susceptible hybrid.

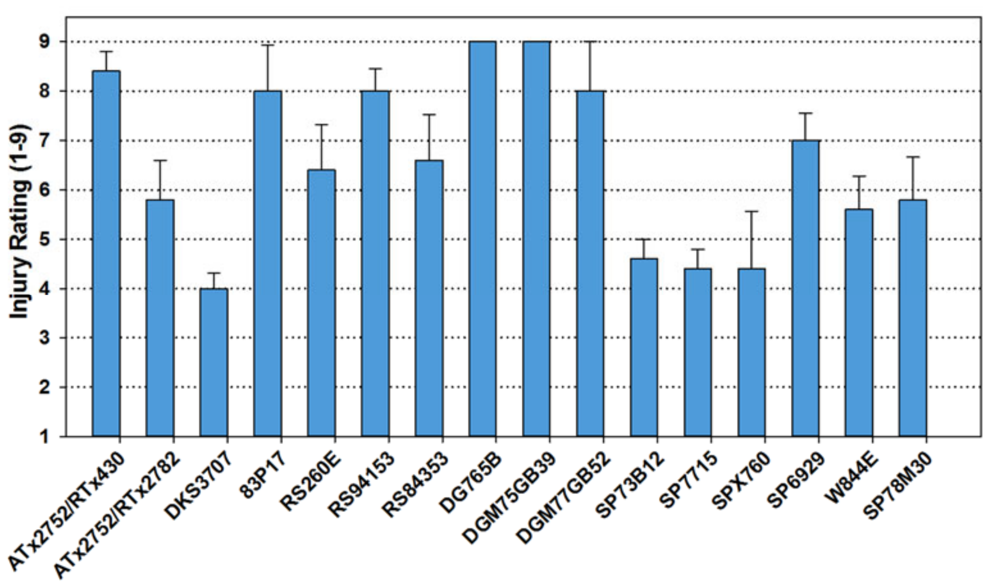

Figure 5. Seedling Injury Screen: 1=dead plant 9= healthy plant.

Summary

Currently, there are commercially available hybrids that offer resistance or tolerance to the SCA. These hybrids have shown a reduction in aphid days or aphid colonization as well as less feeding injury, which allows the full yield potential of the hybrid. According to the hybrids tested, DKS 37-07 appears to offer the most resistance of any hybrid with a number of other hybrids that offer resistance/tolerance including; R84353, R9813, SP6929, SP73B12, SP7715, SPX760, SP78M30, P-83P17, and W-844-E, while M75GB39 appeared to be the most susceptible in both evaluations.

Although hybrids may offer resistance or tolerance to the SCA, this does not mean insecticide applications are not necessary. However, picking a resistant hybrid may give growers a longer period of time before insecticide applications are needed. In the state of Louisiana, Transform and Sivanto are the insecticides of choice for controlling the SCA. These insecticides offer the best efficacy and residual control, while preserving beneficial insect populations. Preserving beneficial insects can also be achieved by scouting for midge when plants begin to flower, instead of automatic applications of disruptive pyrethroids. Additionally, managing the sugarcane aphid can be done before the hybrids are planted. Planning for control early is very important in preserving the hybrids full yield potential. This can be achieved through landscape management, by clearing fields of any secondary hosts where sorghum may be planted. Early planting and insecticide seed treatments have also proved to be a useful tool in controlling the SCA, even with susceptible hybrids. Early planting is a good tool that may allow the sorghum to mature through the susceptible stages before SCA populations begin to move into fields, and seed treatments allow further protection during these susceptible growth stages.

References

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