Sugarcane Aphid on Sorghum: Control and Decision-making & Evaluation and Outreach Education in the Upper and Lower Gulf Coast and Central Texas

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I. Optimizing control using spray application technology and harvest period strategies.

Use of different spray nozzles for increased canopy penetration

In Rosenberg, a spray test was conducted where seven different nozzle types were arranged in 10 configurations to investigate differences in canopy penetration. A producer-provided Spray-Coupe was used to apply 10 gallons per acre (~60 psi at ~14 mph) to boot/heading sorghum. Water sensitive spray cards were placed on individual plants in four locations throughout the canopy, with four replications each, to determine spray coverage by each nozzle type for each portion of the canopy. Although there were numerical differences, there was no statistical difference ($p=0.05$) in spray coverage at any level of the canopy.

In Corpus Christi, the application was made with a plot sprayer at 20 gpa. There was no difference in percent coverage at the lower, middle, and upper canopy. However, at the lowest canopy position, near the base of the plant, percent coverage (approximately 7%) of the TeeJet TXR Conejet (8004) was more than double that of any other tip.

Due to wet conditions when aphid populations were highest, we were unable to perform any insecticide efficacy studies to see if coverage and canopy penetration translate into improved efficacy. Additional efforts will be made in 2017.

Near-harvest strategies to mitigate harvest issues

Due to timing of aphid infestations in the upper gulf coast region this season, most producers sprayed 6-8 weeks prior to harvest and aphid populations did not rebound. We are unaware of any harvest issues resulting from honeydew accumulation and the the co-application of insecticide with harvest aid test was unable to be performed. We will continue investigating these potential issues in 2017.

II. Improving decision-making for insecticide use by adjusting thresholds for hybrid sensitivity

Commercial hybrids vary in response to aphids and aphid abundance varies as well. Our two questions addressed were 1) whether ‘R’ (referred to as either tolerant or partially resistant) hybrids were verified under season-long growing conditions and exposure to sugarcane aphid experienced in Texas, and 2) whether adjusting thresholds upward for the ‘R’ hybrids is

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appropriate (that is, they yield better than susceptible 'S' hybrid comparators when exposed to natural populations of sugarcane aphid but the 'R' hybrid still needs to be protected at some higher sugarcane aphid pressure that may occur in Texas)?

At three locations (Corpus Christi, Rosenberg, and Gainesville), resistance in five sorghum hybrids designated by seed companies as "highly tolerant" to sugarcane aphid (SCA) was compared. Suspected 'R' (partially resistant) sorghum entries included SP7715 (Sorghum Partners), BH4100 (B&H Genetics), and DKS37-07 and DKS48-07 (Monsanto). Two SCA susceptible hybrids, DKS38-88 and DKS53-67 (Monsanto), also were included in this trial. All hybrids had Concep III (Syngenta) and fungicide seed treatments. To obtain a range of aphid pressure, Sivanto (4 oz/ac) was sprayed by ground rig when aphids reached 50, 125, 300 sugarcane aphid per leaf. One additional treatment of an unsprayed control allowed aphids to increase naturally. The spray and hybrid treatment combinations were replicated four times. Measurements included weekly aphid counts on 20 leaves total (10 top and 10 bottom leaves). Leaf injury was taken weekly and yield was taken. The peak aphid load was compared across hybrids and a yield—maximum aphid load regression was done.

Planting and conditions at the three locations:
Plots in the Upper Gulf Coast, near Rosenberg, were planted in early May. Aphid populations showed up early, first noticed in the 3-4 leaf stage. Most hybrids were sprayed at the 50 and 125 aphids/leaf trigger and one hybrid was sprayed at the 300 aphids/leaf trigger before populations started to decline around 6/12. Harvest occurred in mid-August.

Plots in the North-Central Texas location, near Gainesville, were also planted in early May. Aphids arrived later with first detection occurring on June 12 at V 4-5. The aphid population expanded slowly into late July. Both susceptible hybrids were sprayed at the 50 and 125 ET level on July 22. Two of the resistant hybrids were sprayed at the 50 ET level on July 31. No hybrids in the 300 ET level ever reached threshold. In mid-August, there was a rapid decline in the aphid population. Harvest occurred in mid-September. Rosenberg and Gainesville results were similar, and Rosenberg data are shown here to represent the trends.

A planting in the lower Gulf Coast location, near Corpus Christi occurred on April 4. First detection of sugarcane aphid occurred on May 4 at V 3-4. The two susceptible hybrids were sprayed at the 50 ET level on May 25. Sugarcane aphid numbers remained very low in these plots. On July 13, one of the susceptible hybrids was sprayed at the 125 ET level. Susceptible hybrid plots of 300 ET had healthy sugarcane aphid populations but remained below threshold. None of the resistant hybrid plots were sprayed. Harvest occurred on July 26. An infestation of yellow sugarcane aphid in early May. They built to moderate levels before falling off to undetectable levels. The susceptible hybrids seemed to suffer the most damage from yellow sugarcane aphid. This added aphid pressure along with some bird damage led to highly variable yield data at this location; therefore these data were only used to evaluate aphid pressure on the hybrids and not yield.

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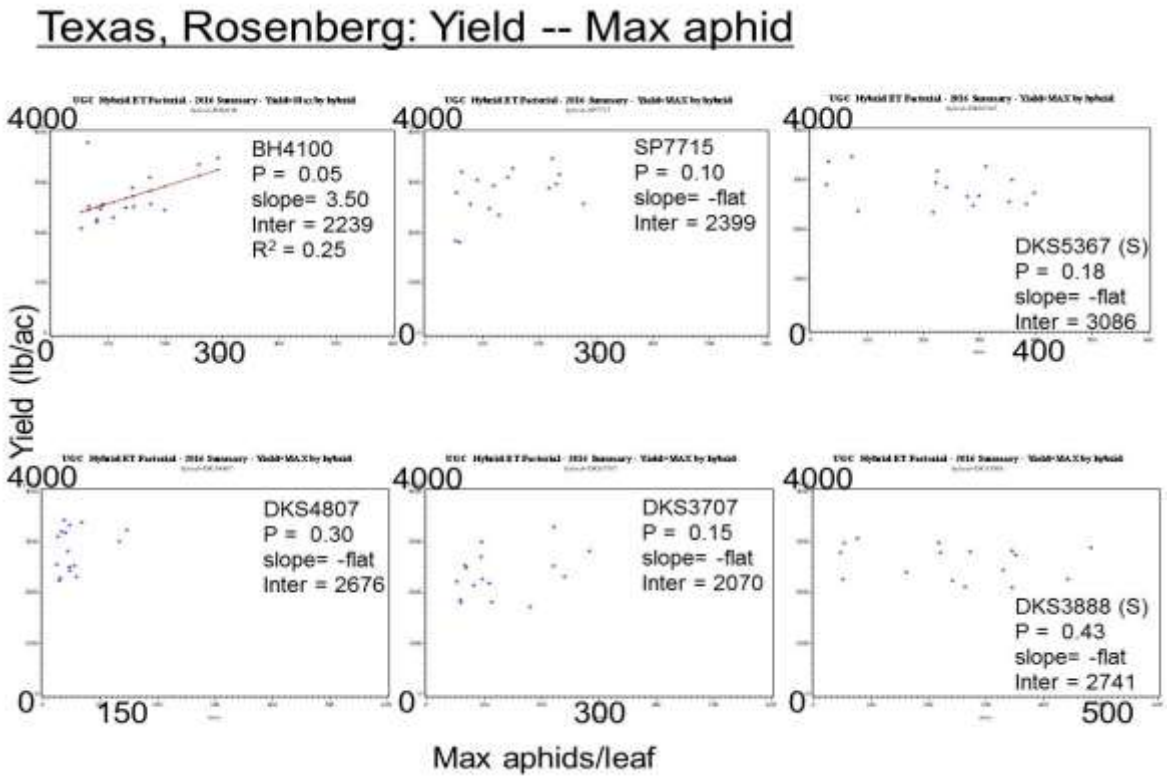
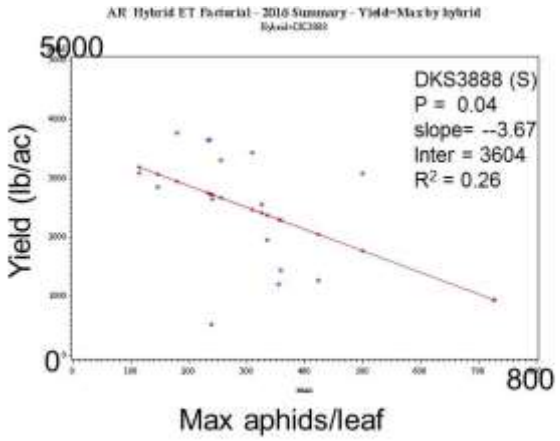


Moderate to high aphid pressure, good growing conditions, and initial aphid infestations occurring before boot stage were experienced in the three locations. Selected 'R' hybrids (SP7715, BH4100, DKS37-07 and DKS48-07) maintained aphid densities below 100 aphids per leaf with no leaf injury (not shown here) at Corpus Christi. At Rosenberg where aphid pressure was greatest, BH4100 and SP7715 had peak aphid populations at 300 aphids per leaf, and DKS4807 and DKS3707 had peak aphid populations at 200 aphids per leaf. No yield loss was detected. The two 'S' comparators (DKS 5367 and DKS3888) had peak aphid populations as high as 500 aphid per leaf, but little yield decline was detected under the excellent growing conditions in Rosenberg.



In a companion study in Arkansas supported by United Sorghum (see right graph) and results from previous years supported by the Texas Grain Sorghum Board (see below), you can see yield starts declining above peak aphid densities of about 150 aphids per leaf. This translates to range of ETs for 4 'S' hybrids. Operationally, an ET of 50 aphids per leaf when infestations occur during vegetative growth is commonly used.

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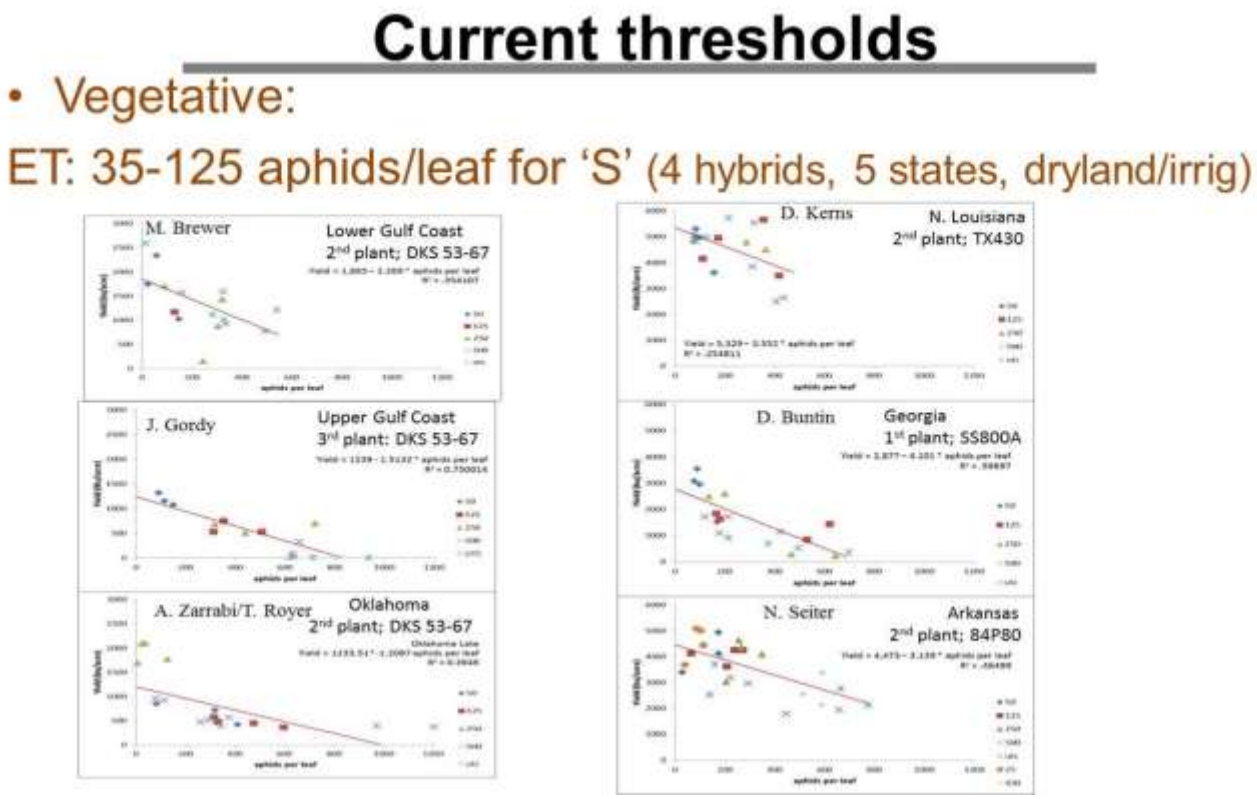
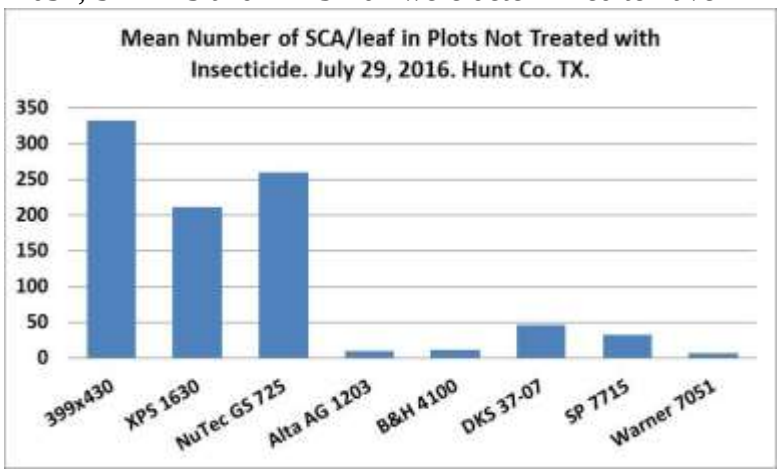


Additional Field Screening of Sorghum Hybrids for Aphid Resistance:

Hunt County. Seven commercial hybrids suspected to be resistant or tolerant to sugarcane aphid along with a susceptible check were planted in a split block design with four replications on May 13 in Hunt County. Plots were eight rows wide and divided into two 4 row subplots. One subplot was treated with Sivanto insecticide on July 16 and the second plot left untreated. Sugarcane aphid densities and plant damage were recorded on four dates. Grain yields were determined in insecticide treated and untreated subplots within hybrids. However, yields were low and variable due to drought stress and yield differences within a hybrid were not significant. Five hybrids, AG 1203, BH 4100, W- 7051, SP 7715 and DK 37-07 were determined to have some resistance or tolerance to sugarcane aphid as aphid densities in these hybrids remained below the treatment threshold of 50 aphids/leaf throughout the growing season and exhibited no leaf damage due to SCA. In contrast, aphid densities in NuTech GS 725, XPS 1630 and the susceptible check (Tx399 x Tx430) averaged 210-330/leaf, well above the treatment threshold, and these three hybrids suffered 50-65% leaf



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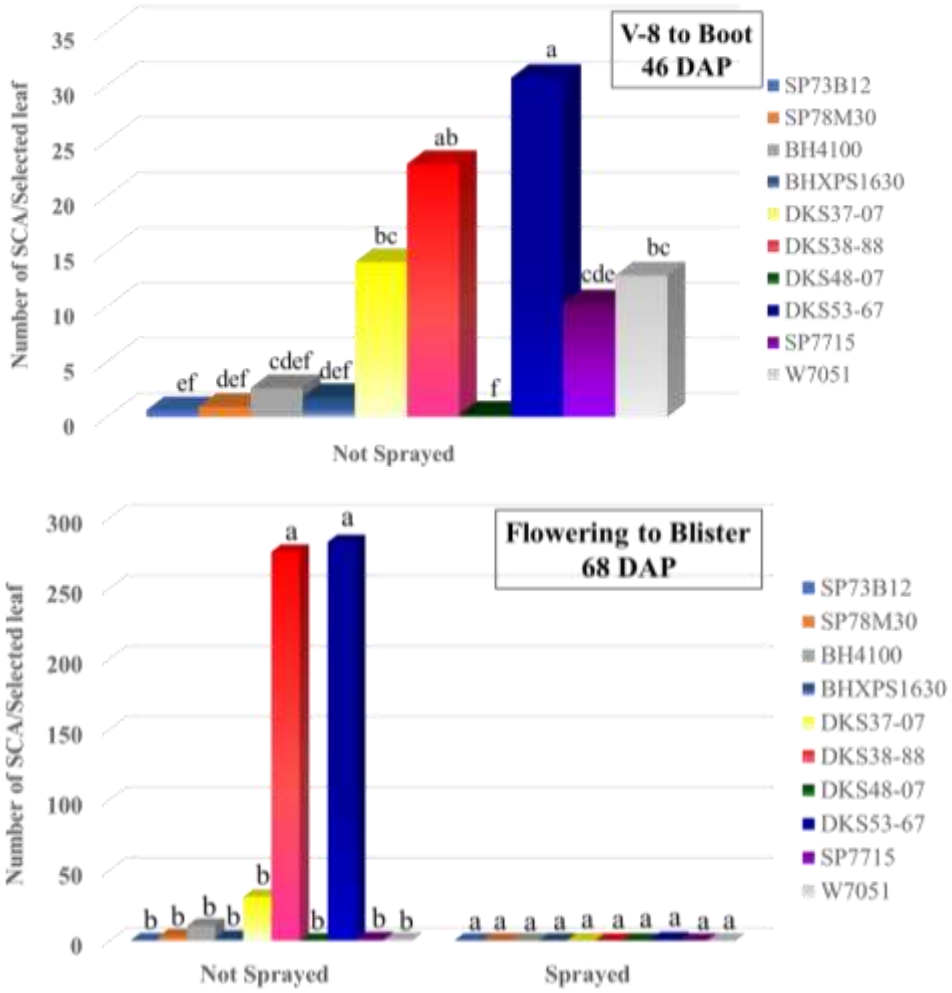
death due to SCA feeding.

Corpus Christi fall planting. On October 6, 2016 a sugarcane aphid trial was planted at the Texas A&M Agrilife Research and Extension Center (Corpus Christi) to evaluate resistance in eight sorghum hybrids designated by seed companies as "highly tolerant" to sugarcane aphid (SCA). Tolerant sorghum entries included SP73B12, SP78M30, SP7715 (Sorghum Partners), BH4100 (B&H Genetics), W7051 (Warner), and DKS37-07 and DKS48-07 (Monsanto). Two SCA susceptible hybrids, DKS38-88 and DKS53-67 (Monsanto), also were included in this trial. All hybrids had Concep III (Syngenta) and fungicide seed treatments. Roundup WeatherMAX® (Monsanto) was applied at 28 oz/a was applied prior to planting. On October 19 the trial was treated with iron to ameliorate iron chlorosis issues.

Sorghum hybrids designated by seed companies as "highly SCA tolerant" had fewer SCA during early vegetative growth through grain development when compared to sorghum susceptible to the aphid. The slow SCA population growth compared to susceptible hybrids suggests antibiosis as a resistance factor in hybrids designate as "highly tolerant" to SCA. That is, aphids are killed or their reproductive aphid is reduced when on these hybrids.



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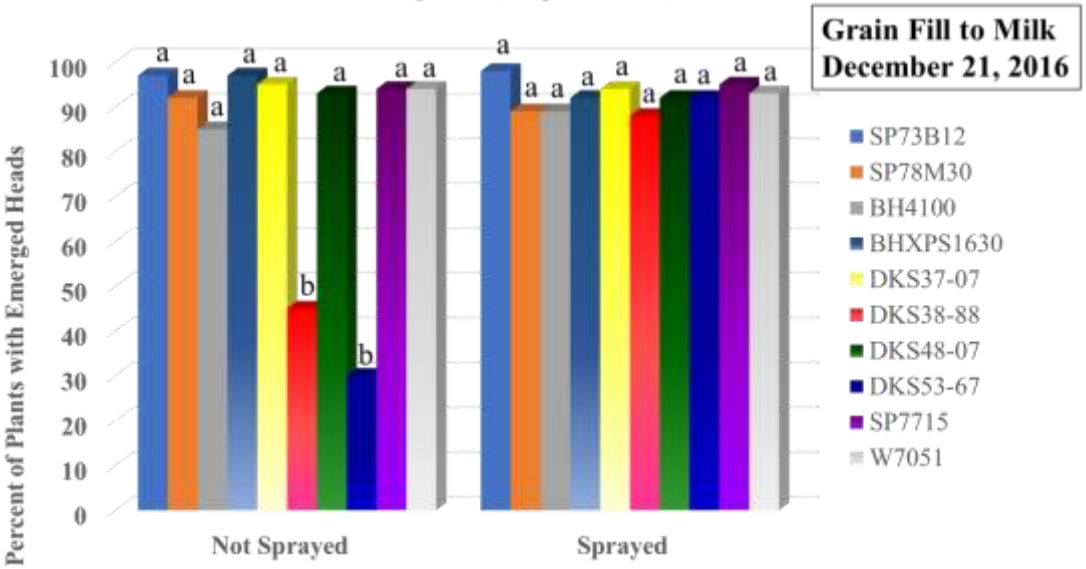
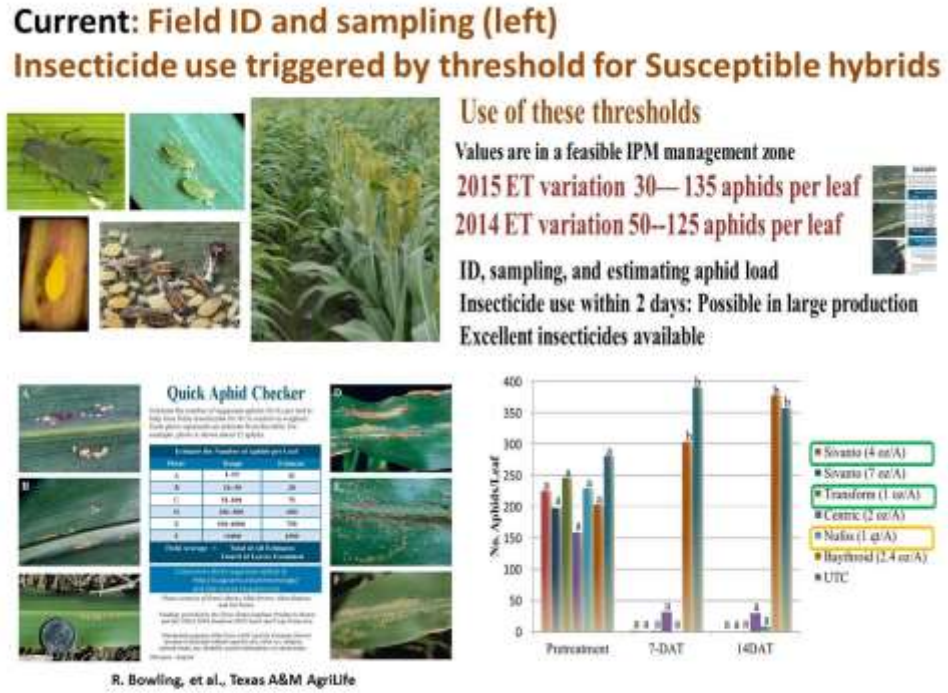
These partially resistant (or tolerant) hybrids had little to no visible signs of plant injury by SCA; whereas SCA susceptible sorghum hybrids were severely damaged when not treated with Sivanto. The ability of SCA tolerant sorghums to limit SCA population growth and damage protects the yield potential of these hybrids. This potential was observed by head emergence among hybrids not treated with Sivanto (see below). Hybrids with SCA tolerance either maximized or were close to maximizing head emergence in this trial. SCA susceptible hybrids suffered extensive injury by SCA and a small percentage of plants exerted heads.



Guidance on use of partially resistant hybrids.

Well timed application(s) of an insecticide can protect high yielding aphid susceptible hybrids from economically damaging populations of sugarcane aphid when using an economic threshold of 50 aphids per leaf. Essential in using this strategy is to **Scout fields for aphids on at least a weekly basis** and **Spray within a few days of exceeding threshold**. The scouting card and insecticide use guidelines produced with support from the Board



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(see below) helps guide this effort.

For those considering growing commercial 'tolerant' hybrids, current season-long research confirms that most but not all of these hybrids express partial protection of plants from sugarcane aphid. With these first year results, we are able to provide initial guidance on adjusting thresholds upward for these hybrids, under the good growing conditions we experienced in three locations. For these hybrids, **adjustment of thresholds to a level at or above the ET in the right 'Adjusted ET' column was supported**. We advise additional testing at and above these levels to **verify this work and obtain more specific values under a range of growing conditions and locations**.

Threshold Adjustment Guidance

Hybrid	Maturity	Aphid max Aphids/leaf	Yield loss	Current ET	Adjusted ET
DKS 37-07	Early	100-200	no	50	≥150
DKS 38-88 (S)	Early Late/Med	500	variable	50	50
DKS 48-07	Med	100-200	no	50	≥150
BH 4100	Med/Full	100-300	no	50	≥200
REV9782	Med/Full	200-400	yes	50	50
DKS 5367 (S)	Full	500	variable	50	50
SP 7715	Full	100-300	no	50	≥200

Based on one year 2016 research at 3 locations in good growing conditions. Additional research is advised for verification and to provide more specific guidance applicable to a range of growing conditions and locations.

III. Economic Evaluation and Outreach education through face to face meetings and online resources.

An Excel-based decision aide tool for aiding a producer's economic decision to treat sugarcane aphids was developed, tested, and distributed to producers. The economic thresholds were based on the 2014-2015 research sponsored by the Texas Grain Sorghum Producers Board. In 2016, the Excel tool was posted on the Texas A&M AgriLife District 11 (Coastal Bend) web-site (http://agrilife.org/coastalbend/program-areas/entomology/sugarcane-aphid-on-sorghum/).

Outreach education efforts have also included 8 workshops at county Extension or professional meetings with 576 producers and professionals in attendance along the Coastal Bend. Programs to growers on managing sugarcane aphid on sorghum were conducted at 27 meetings in the northern and central Blacklands, the Upper Gulf Coast, south Texas and the Rio Grande Valley and attended by 846 growers during January-June, 2016.

In 2016 the USEPA approved a Section 18 request for use of Transform to manage sugarcane aphid on sorghum in Texas. The most recent label has a restriction on application timing (no applications 3 days prior to flowering until seed set). The USEPA also approved a Section 24C request for Sivanto relaxing the pre-harvest interval (PHI) from 21-days to 14-days. Texas A&M Agrilife Extension led the outreach educational programming to Texas Sorghum Producers on proper application timing to prevent possible misapplications and avoid exposing

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pollinators to Transform and the reduced pre-harvest interval for Sivanto as specified in the USEPA's Section 24C label.

Resources Developed partly supported by the Texas Sorghum Producers Board:

Knutson, A., R. Bowling, M. Brewer, E. Bynum, and P. Porter. 2016. The Sugarcane Aphid: Management Guidelines for Grain and Forage Sorghum in Texas. Texas A&M AgriLife Extension and Research, Texas A&M University.NTO-035.

Bowling, R., M. Brewer, A. Knutson, S. Biles, D. Sekula-Ortiz. 2016. Scouting Sugarcane Aphids in South, Central, and West Texas. Texas A&M AgriLife Extension and Research, Texas A&M University. NTO-043. NTO-043S (Spanish version).

Russell, L., M. Young, R. Bowling, M. Brewer, and J. McGinty. 2015. Sugarcane aphid treatment decision tool for grain sorghum. Xcell program and instructions available at http://agrilife.org/coastalbend/program-areas/entomology/sugarcane-aphid-on-sorghum/

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Brewer, M.J., R. Bowling, J.P. Michaud, and A.L. Jacobson. 2016. Sugarcane aphid: a new sorghum pest in North America, 2 pp. ENTO-056. Texas A&M AgriLife Extension Service, College Station, TX. (accessible at http://ccag.tamu.edu/files/2016/08/ENTO-056-2016.pdf)

Thomas, J., R. Bowling, and M. Brewer. 2016. Better yield in the field web site (a web site of field crop insect pest management resources, publication, webcasts, and other materials with initial focus on sugarcane aphid, accessible at http://betteryield.agrilife.org/).

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