## Project

Sugarcane Aphid of California Forage Sorghum Insecticide Efficacy Trial

## Authors

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## Period

Summer, 2017

## Site

Kern County Cooperative Extension research farm, Shafter, CA

## Introduction

Sugarcane aphid (SCA) – *Melanaphis sacchari* – is a serious insect pest of sorghum in the US. Infestations of CA forage sorghum first occurred in summer, 2016, in the southern San Joaquin Valley (SJV). Local county Ag Commissioners, UCCE Advisors, and the CDFA confirmed the presence of a SCA as an invasive species in CA after samples were submitted from fields where broad-spectrum insecticide materials showed little to no efficacy at controlling the bug.

The CA sorghum cropping system is unique from the rest of the US in that it is dominated by forage production for dairy animals. Plenty of research conducted in the US exists to support pest management recommendations for SCA in sorghum, but it is almost exclusively targeted at grain production. Bowling et al. (2016), studied the effect of sulfoxaflor on SCA in forage sorghum and hay quality and showed that treatment reduced aphid population but did not have an effect on hay quality. It is probable that aphid numbers did not reach sufficient levels to impact hay quality in that study (a maximum of about 25 aphids/leaf was reported). Heguy at al. (2017), studied the impact of SCA infestation of forage sorghum on dairy feed quality at harvest. That study showed that between 16 study dairies, significant reductions in starch and non-fibrous carbohydrate and increases in acid-detergent fiber, ash, and crude protein probably resulted from severe SCA infestation.

This project aimed to study the impacts of insecticide spray treatments on SCA population, crop yield, and feed quality in forage sorghum.

## Methods

One acre of sorghum cultivar NK-300 (safened) was planted on June 22, 2017, at 100,000 seed/acre to moisture on 30” beds. Fertilizer, irrigation, and weed management programs were executed to imitate common commercial practices for the region (Table 1). The field was divided into 28 plots (16 rows x 35 ft) in a randomized complete block design of four replications of six treatments and an untreated check (Table 2).

On August 9 sugarcane aphid were collected from commercial fields in Corcoran, CA, transported to the research plots, and distributed onto the sorghum leaves. A total of 64 infested leaves were distributed within each plot. Aphids populations were allowed do get established in the field and increase naturally for approximately three weeks before the trial was initiated.

Insecticide applications were made on August 31, 2017 at the initiation of sorghum heading using a high clearance spray rig with an 8 row boom and drop nozzles. However, due to issues related to the interlocking of sticky leaves and lodging, it was only possible to make applications to 8 rows of sorghum in each of two of the replications. The other rows were impenetrable without knocking over the entire crop. As a result, the trial was modified to a randomized complete block design with two replications of 8-row (20 ft) by 35 ft plots.

Aphid populations were monitored at approximately five day intervals from Aug 31 through harvest. This was done by counting the total number of aphids on one half of the underside of each of ten leaves from the center two rows of each plot, and then multiplying by two. Leaves were chosen at random from fully expanded leaves approximately four feet from the ground. Data were averaged to determine the average number of aphids per leaf in each plot. At the end of the trial a cumulative calculation of aphid-days was made by determining the average number of aphids between each sampling data multiplied by the number of dates between the dates.

Harvest was performed at dough stage on October 8, 2017 using an Almaco small-plot, 2-row forage chopper on 4 middle rows of each plot. Sub-samples of chopped sorghum from each plot were collected, weighed, dried at 55° C in a forced air oven, and weighed again to calculate moisture content. These sub-samples were then sent for feed quality analysis. During harvest, notes were taken on planting skips and lodging in order to estimate random effects on the yield. No significant lodging or skips in harvested portions of the plots were observed.

Data were analyzed as a completely randomized design with two replications using MS Excel Data Analysis ToolPak and IBM SPSS v. 24. Aphid-day data were square-root transformed prior to statistical analysis to satisfy model assumptions related to homogeneity of variances. Analysis of insecticide treatment on yield and aphid-days was performed using the SPSS unilinear generalized linear model to initially test for a main effect of replicate in the ANOVA model. No effect of replicate was observed, so a one-way ANOVA was performed on each analysis with insecticide treatment as the fixed factor and aphid-days and yield as the dependent variables. Means were separated using Fisher's protected LSD at $\alpha = 0.05$. A regression analysis was performed using the MS Excel Data Analysis ToolPak regression function.

## Results and discussion

*Aphid population*. Sivanto Prime applied at the rates of 4 and 7 fl. oz./acre reduced cumulative aphid-days by 78 and 92%, respectively (Table 2 & Figure 2). However, this reduction was not significant due to limited (two) replications. The effect of Transform WG applied at 1.5 fl.

oz./acre on cumulative aphid-days was similar to the untreated control and broad spectrum materials tested. The broad-spectrum insecticides Malathion, Dimethoate and Lorsban Advanced all resulted in less than a 50% reduction in cumulative aphid-days. There was only one day (34 DAT) when aphid-days were significantly impacted ($P = 0.024$) by insecticide treatment, and that day appears to be anomalous within our data set.

Data suggest that Sivanto is currently the best candidate for control of sugarcane aphid in California forage sorghum. This is consistent with data collected from multiple trials on grain sorghum in the southern US. Also consistent with data from the south is that broad spectrum insecticides, although less expensive than Sivanto, do not provide sufficient control to justify their use. We do not feel it is appropriate to make any statements regarding the efficacy of Transform from this trial due to the inconsistency between our results and results from research in the south, especially considering that our trial was limited to two replications at one site.

*Yield*. Treatments with Sivanto Prime applied at 4 and 7 fl. oz./acre had the highest average yields, followed by Transform WG applied at 1.5 fl. oz./acre which was similar to Dimethoate 4EC applied at 16 fl. oz./acre (Table 3 and Figure 1). The untreated control and other broad spectrum insecticide treatments on average yielded less. No treatment differences had a statistically significant impact on yield, and this was probably due to data only being collected from two replicates.

Cumulative aphid-days had a negative impact on yield (Figure 3), but the effect was not statistically significant. A line fit of cumulative aphid days versus yield showed that from approximately 0-4,000 cumulative aphid-days the relative negative impact on yield is severe compared to cumulative aphid-days greater than 4,000. Although these results agree with studies from the southern US in which aphid-days were inversely proportional to yield (of grain), our results are only preliminary visual comparisons. Better replication of data may have demonstrated a statistically significant effect.

*Feed quality*. Samples from two replicates of each treatment were sent to Rock River Laboratory to be evaluated for ash, crude protein, neutral-detergent fiber, 30 hour *in vitro* neutral-detergent fiber digestion, acid-detergent fiber, lignin, starch, and fat using wet chemistry analyses. No results area available yet.

**Acknowledgments**

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## Tables and figures

Table 1. Trial conditions

| Trial parameter | Date/Frequency | Variable |
|---|---|---|
| Cultivar: | | NK-300 |
| Planted: | 6/22/2017 | |
| SCA augmented: | 8/10/2017 | Crop stage V10 |
| Treated: | 8/31/2017 | Crop stage: early heading |
| Harvested: | 10/9/2017 | Crop stage: dough |
| Herbicide: | | Dual Magnum, AAtrex, and Roundup |
| Cultivated | 7/6/2017 | |
| Fertilized | 7/14/2017 | 80 lbs. N/ac |
| Crop rotation | | Alfalfa |
| Pre-irrigated | | 8 inches |
| Irrigated | ~ every 10 days | 24 inches total |

Table 2. Effects of insecticide treatments on aphid density in forage sorghum

| Treatment | Rate form. prod/acre | Mean aphids per leaf ± SEM[1] | | | | | | | | Cumulative aphid-days |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 DAT | 12 DAT | 15 DAT | 20 DAT | 26 DAT | 29 DAT | 34 DAT | 39 DAT | |
| UTC[3] | N/A | 11 ± 6 | 292 ± 176 | 349 ± 246 | 292 ± 100 | 647 ± 326 | 354 ± 234 | 25 ± 21 ab | 28 ± 10 | 8942 ± 1728 |
| Sivanto Prime | 4 fl oz | 16 ± 16 | 105 ± 104 | 101 ± 98 | 63 ± 55 | 8 ± 6 | 54 ± 52 | 37 ± 33 ab | 57 ± 56 | 1940 ± 764 |
| Sivanto Prime | 7 fl oz | 12 ± 12 | 34 ± 34 | 67 ± 67 | 1 ± 1 | 2 ± 0.2 | 8 ± 6 | 4 ± 1 a | 8 ± 6 | 700 ± 432 |
| Transform WG | 1.5 fl oz | 82 ± 74 | 756± 752 | 462 ± 453 | 44 ± 39 | 143 ± 57 | 2 ± 0.2 | 120 ± 7 bc | 59 ± 29 | 8643 ± 5256 |
| Malathion 57% | 24 fl oz | 48 ± 40 | 141 ± 140 | 231 ± 225 | 229 ± 180 | 352 ± 337 | 733 ± 729 | 265 ± 82 c | 129 ± 127 | 9419 ± 7402 |
| Dimethoate 4EC | 16 fl oz | 35 ± 19 | 164 ± 123 | 336 ± 179 | 426 ± 364 | 285 ± 187 | 87 ± 70 | 30 ± 25 ab | 13 ± 7 | 6553 ± 1786 |
| Lorsban Adv. | 32 fl oz | 1 ± 0.4 | 25 ± 25 | 54 ± 50. | 41.9 ± 34 | 78 ± 49 | 618 ± 389 | 191 ± 82 c | 192 ± 19 | 4824 ± 2639 |
| *F statistic*[4] | | *0.777* | *0.499* | *0.454* | *1.542* | *2.095* | *0.777* | *5.166* | *1.262* | *1.377* |
| *P-value*[4] | | *0.613* | *0.792* | *0.822* | *0.291* | *0.178* | *0.613* | *0.024* | *0.380* | *0.340* |

Means ± SEM within a column followed by identical lowercase letters are not significantly different according to Fisher's LSD[4] at $\alpha = 0.05$.

[1] Standard error of the mean

[2] Days after treatment

[3] Untreated control

[4] Inferential statistics performed and reported after square root transformation of "aphid-days" variable. All means and SEM data presented are non-transformed.

Table 3. Insecticide Treatment Effect on Crop Yield

| Treatment | Application rate fl. oz./acre | Yield ± SEM Tons @ 70% MC[1]/acre | Harvest MC ± SEM % |
|---|---|---|---|
| UTC | N/A | 29.4 ± 2.5 | 64.1 ± 0.9 |
| Sivanto Prime | 4 | 37.6 ± 2.32 | 65.5 ± 0.02 |
| Sivanto Prime | 7 | 43.1 ± 1.1 | 66.0 ± 0.6 |
| Transform WG | 1.5 | 34.34± 5.8 | 66.4 ± 0.3 |
| Malathion 57% | 24 | 25.8 ± 4.0 | 64.7 ± 3.1 |
| Dimethoate 4EC | 16 | 33.9 ± 5.6 | 63.9 ± 1.5 |
| Lorsban Advanced | 32 | 25.8 ± 10.2 | 64.9 ± 0.7 |
| *F statistic* | | *1.437* | *0.434* |
| *P-value* | | *0.321* | *0.836* |

[1] Moisture content

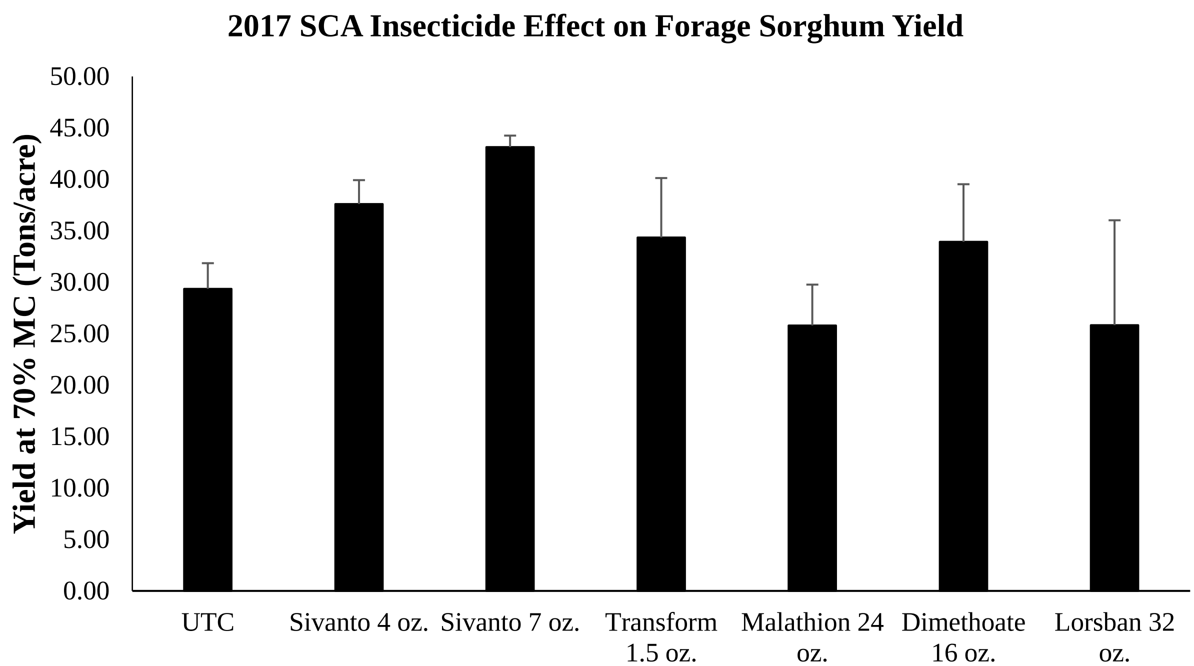


Figure 1. Effect of insecticide treatment on forage sorghum yield corrected to 70% moisture content. Bars represent the standard error of the mean.

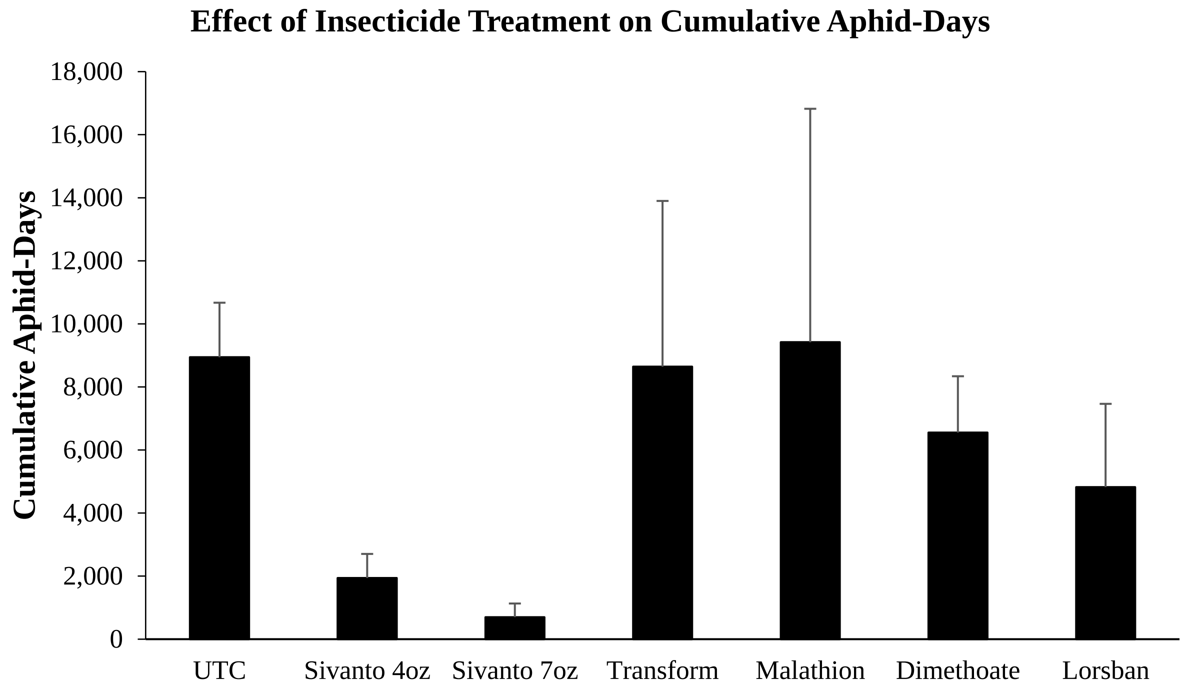


Figure 2. Effect of insecticide treatment on cumulative aphid-days. Bars represent the standard error of the mean.

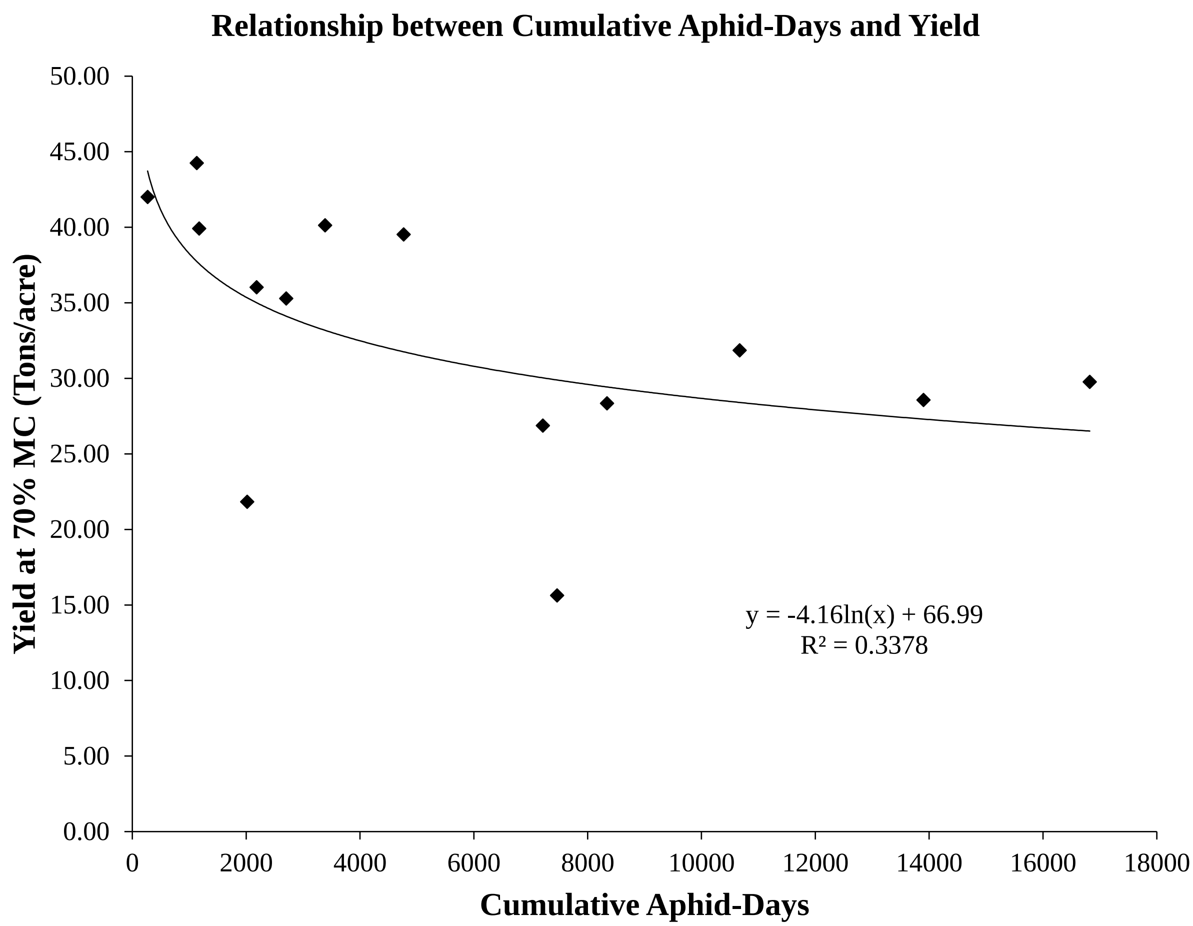


Figure 3. Regression and natural log-linear model fit of cumulative aphid-days versus yield. Regression *t* test is not significant with $P = 0.085$.