Soybean plots with sudden death syndrome (SDS) and drought tolerance traits were established in Salina, and Rossville. Crop established well in 2017, but unfortunately, most of the soybean plots with studies on drought resistance were heavily damaged by Dicamba drift. Aerial imagery was collected using mission using Sony alfa 5100 broadband color infrared camera (CIR) at Rossville and one at Salina; and five missions at Rossville and one at Salina using FLIR vue Pro R thermal infrared (TIR) sensor. IRIS+ was used as small-unmanned aerial system (sUAS). At Rossville location spectral data was also collected using handheld spectrometer. Ground reference panels with thermistors for developed for temperature to sensor response calibration. Aerial mission was conducted 80 m and 77 m altitude for CIR and TIR sensors respectively. Aerial imagery was stitched using Agisoft PhotoScan modeling software. For all test plots, SDS scores, wilting scores, yields and plant height were collected. All test plots were geo-tagged using real-time kinematics (RTK) Global Positioning System (GPS). Ground control points at seven locations within the field of view of aerial mission were geo-tagged and setup for modeling software. Spatial analysis of orthomosaic constructed from aerial images was conducted in ArcMap GIS software to generate Pigment index (PI) and canopy temperature (CT) maps. Statistical analysis was conducted to derive correlation between PI and SDS; PI and Severity; CT and SDS; and CT and DT.

The results indicated that PI derived using aerial imagery showed a strong negative correlation to the SDS scores for checks and high scoring SDS plots in 2016. Analysis of PI from aerial imagery as a detector of SDS provided results comparable to ground-based system. Results indicated that PI derived using aerial imagery exhibited slightly stronger correlation (R2 = 0.7974) with SDS scores as compared to ground-based spectrometer data (R2 = 0.7809). Analysis of only high instances of SDS showed that aerial data had variability with R2 = 0.8359 (ground data R2 = 0.7114). Correlation between SDS scores and different indices analyzed exhibited that PI and BNDVI had statistically significant results with PI showing greater correlation (-0.7916 and -0.7163) than BNDVI. **Error! Reference source not found.** The aerial imagery and ground-based data showed strong correlation indicating that aerial data could be applied to spatial maps to score SDS.

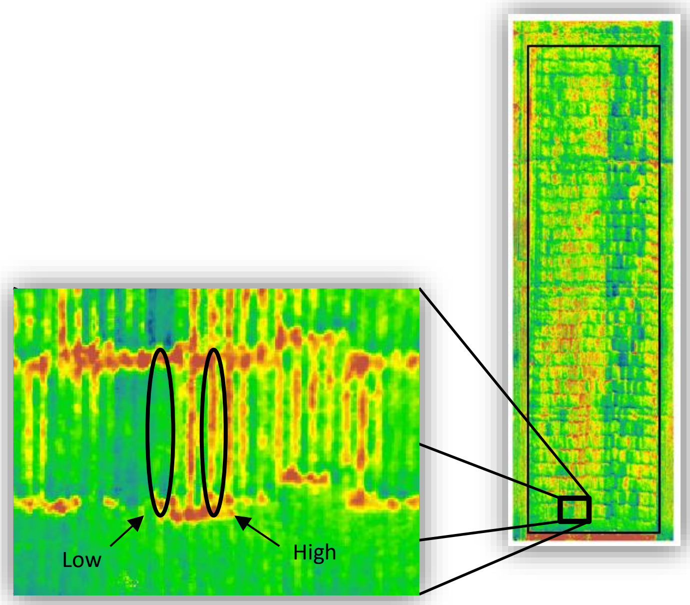

Figure 1. Example map showing correlation of high and low instances of SDS scores and PI

TIR data from four aerial imaging missions in 2017 showed that SDS infected canopy showed elevated canopy temperatures. Elevated canopy temperature changes were observed on canopies at early SDS symptom development. Symptoms at the end of the growing season displayed strong correlations to the canopy temperature with ρ= -0.7114. Disease severity showed the strongest correlation throughout the four flights with the last at ρ= -0.7115. The four flights exhibit a decreasing trend with Spearman's rho (R2=0.7859 for disease severity). Therefore, thermal imaging can be utilized to detect diseased plots. Future studies will be conducted to understand how to mitigate for SDS using thermal detection.

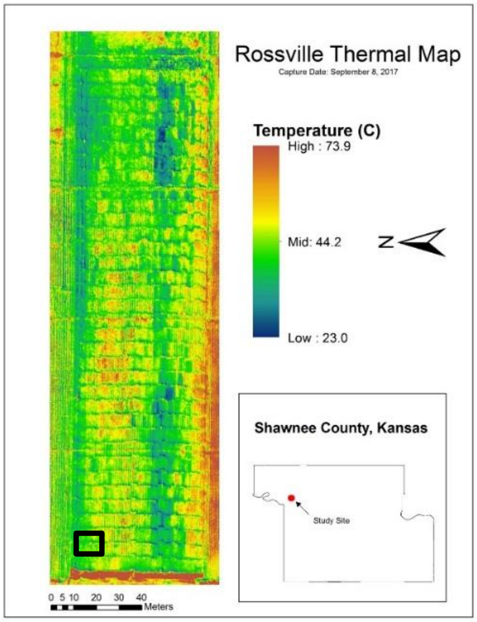

Figure2. SDS infected plants exhibited elevated canopy temperatures

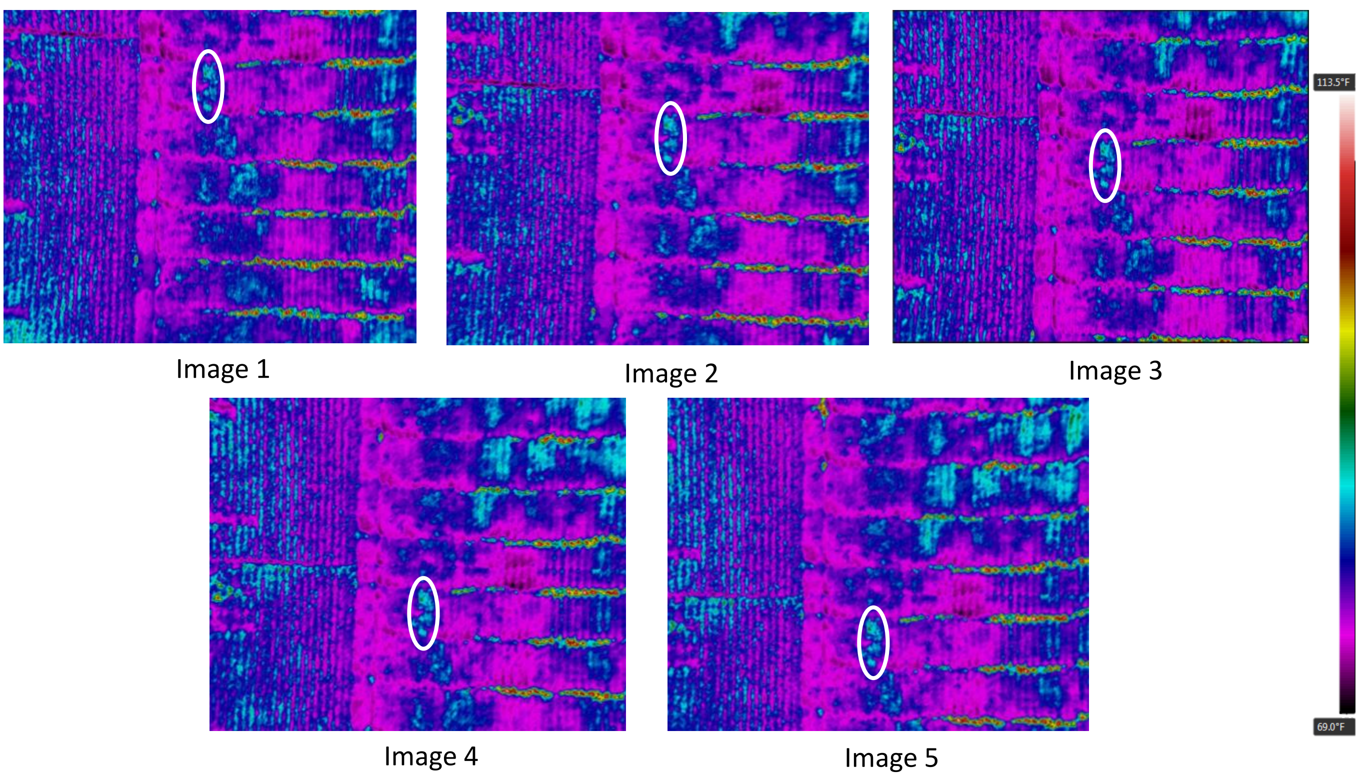

Figure 3. – Example sequence of image selection for calculation of average canopy temperature of SDS infected plots. Plot 121 circled to show relative position in each image.

TIR data during 2017 could not be utilized for drought studies due to severe damage to crop from Dicamba drift. However, the data analysis showed that canopy temperatures of Dicamba resistant (45.025 C)and non-resistant (49.028 c) were statistically different, exhibiting varying yields 31.39 bu/ac and 28.6 bu/ac respectively.

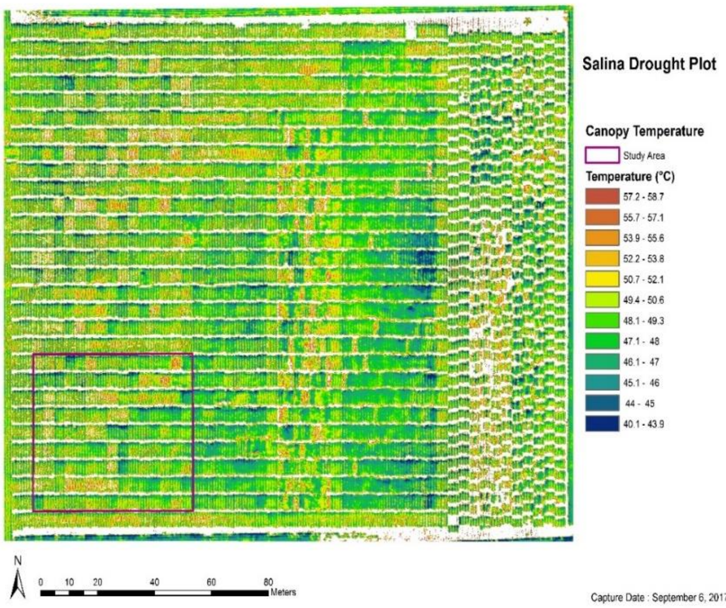

Figure 4. Example canopy temperature map generated using TIR aerial imaging