The Vegetation Index Time Series Imagery Tool (VITSIT)

Problem Addressed: In-season crop monitoring requires comparing crop canopy within fields and over time. Unlike measuring temperature or yield (both of which have specific units of measurement), the digital data of imagery (in raw format) do not have a universal scale system. When imagery, in raw format, are used to conduct analyses, the results are problematic. For example, if raw digital data are used to produce a "crop health map" from last August, it cannot be compared to an image of a different field taken last August, or the same field taken on a different day.

The Vegetation Index Time Series Imagery Tool (VITSIT) was developed to

- Communicate difference between uncalibrated and calibrated imagery sources;
- Report time series of different vegetation indices of crop canopy to identify within-field yield corn and soybean variability zones;
- Identify whether temporal patterns for different vegetation indices change during and across growing seasons;
- Report correlation between yield and vegetation indices from the beginning to the end growing season;
- Identify how rainfall changes imagery calibration quality and correlation with yield;

The VITSIT was developed using a RShiny platform.

What was done: Iowa Soybean Association (ISA) partnered with Southern Illinois University Edwardsville (SIUE) to test digital aerial imagery quality at a 200-acre site located a few miles from Collins, Iowa, provided by two farmers.

The ISA Imagery Calibration Site was used since 2015 to test different sources of imagery for:

- Visual quality (e.g., accuracy of spatial registration, mosaicking issues, band inversion, lack of clarity)
- Radiometric imagery calibration quality (e.g., linearity of imagery calibration equations, and reflectance changes of calibration tarps over time)
- Post-collection imagery processing and its potential to produce calibrated vegetation indies of crop canopy

Calibration tarps with known percentage reflectance values were deployed prior to image collection which took place every two weeks during the growing seasons from 2015 to 2019. Having known reflectance values from the tarps allowed for calibration of the imagery taken.

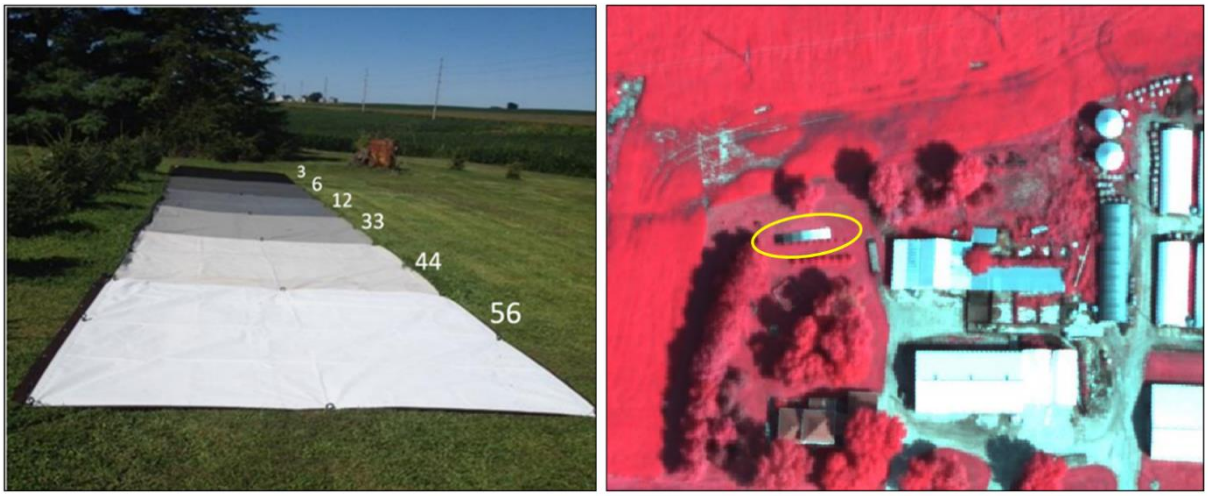
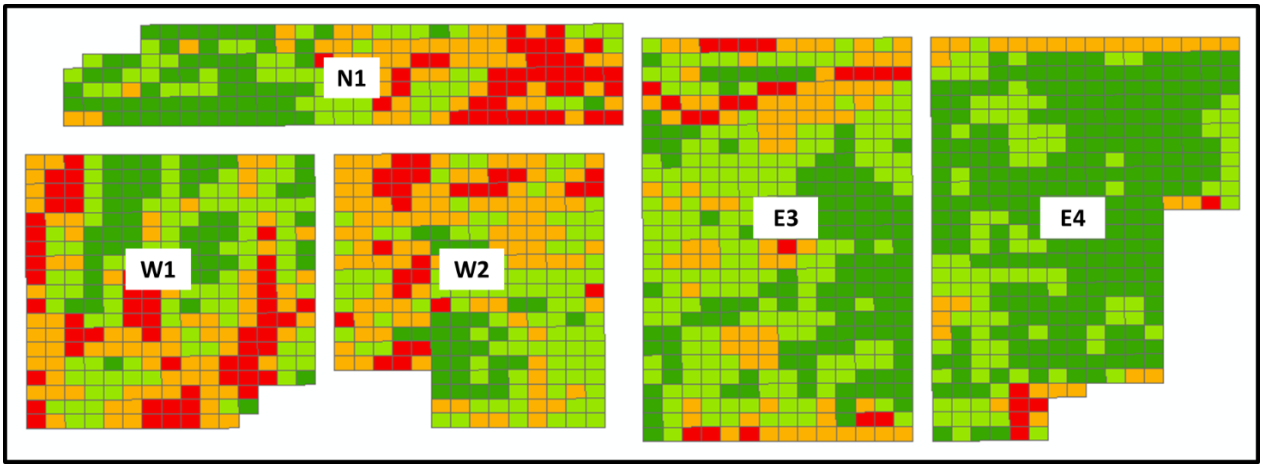


Figure 1. On-the-ground imagery calibration tarps with different percentage reflectance values (left). Tarps as seen in digital aerial imagery (right).

The digital data collected from the calibrated images was then used to generate 12 different vegetation indices (Table 1)

	Vegetative index	Name	Equation
1	CIG	Chlorophyll index green	NIR/Green-1
2	CVI	Chlorophyll vegetation index	NIR*Green/Red^2
3	DVI	Difference vegetation Index	NIR-Red
4	GNDVI	Green normalized difference vegetation index	NIR-Green/NIR+Green
5	Green	Green	Green
6	MSAVI	Modified soil adjusted vegetation index	variable
7	MTVI2	Second modified triangular vegetation index	variable
8	NDVI	Normalized difference vegetation index	NIR-Red/NIR+Red
9	NGRDI	Normalized green difference vegetation index	Green-Red/Green+Red
10	NIR	Near Infrared	NIR
11	SAVI	Soil adjusted vegetation index	variable
12	Red	Red	Red
13	RVI	Ratio vegetation index	NIR/Red
14	OSAVI	Optimized soil adjusted vegetation index	variable
15	TVI	Triangular Vegetation Index	0.5(120(NIR-Green)-200(Red-Green)

Table 1 shows the vegetation indices included and used in the VITSIT tool.



Crop yield was aggregated with 25 x 25-meter grid cells to facilitate for analyses of multiple factors over time.

More information about methodology can be found in the proceeding paper for the 2019 Iowa State University Integrated Crop Management Conference (*link to 2019 ICM paper*).