Detecting Low Rates of 2,4-D Injury in Cotton Using an Unmanned Aerial System

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TEXAS A&M AGRILIFE RESEARCH EXTENSION

INTRODUCTION

- 2,4-D is a postemergence synthetic auxin herbicide that provides selective control of broadleaf plants.
- Cotton is highly sensitive to 2,4-D and will show symptomology at very low rates.
- Off target movement of 2,4-D can reduce or eliminate cotton yield.
- Unmanned Aerial Systems (UAS) have the potential to aid in detecting the extent and severity off-target herbicide movement.

OBJECTIVE

Detect cotton response to low rates of 2,4-D using UAS-based multispectral images.

MATERIALS AND METHODS

Location: Texas Tech New Deal Research Farm

Experimental Design: Randomized Complete Block with 4 replications. 4 rows by 30-foot plots with 40-inch rows.

Crop: DP 1822 XF cotton was planted on May 18, 2020. The spray application was made on July 9, 2020 at first square plus two weeks.

Application: Enlist™ One herbicide was applied to the center two rows with a CO_2-pressurized backpack sprayer at 15 GPA using TTI 11002 nozzles.

Treatments: untreated, X/1000, X/500, X/100, X/50, X/10, 1X; (X =.95 lb ai/ac)

UAS: DJI Matrice 100 with a SlantRange 3P Multispectral Sensor with 4 Bands: Near-infrared (NIR), Red-Edge (RE), Red (R), and Green (G). Flown at 100 feet above ground level.

Software: Images were processed with Pix4D® and analyzed using ENVI®. Statistical analysis was performed with SAS 9.4 PROC GLIMMIX.

Image Resolution: 0.51 in/pixel

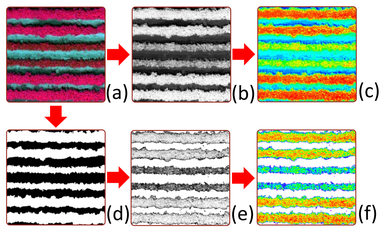
Vegetation Indices:

GOSVI (Green Optimized Soil Adjusted Vegetation Index), **OSAVI** (Optimized Soil Adjusted Vegetation Index), **MSAVI2** (Secondary Modified Soil Adjusted Vegetation Index), **NDRE** (Normalized Difference Red-Edge),

NDVI (Normalized Difference Vegetation Index),

TDVI (Transformed Difference Vegetation Index).

MATERIALS AND METHODS



The vegetation indices were applied and analyzed with and without the soil background pixels (Fig. 2c and 2f). The soil background was removed by conducting a supervised classification of the composite image. The classified image was converted to an image mask where the soil pixels have no value (Fig. 2d). The mask was applied to the vegetation indices, resulting in no soil background (Fig. 2e).

Figure 1. NIR-R-G image of six cotton rows with the center two rows sprayed with a low rate of 2,4-D (a), vegetation index with soil background (b), color scheme applied to the image (c), mask created from supervised classification (d), vegetation index without soil background (e), color scheme applied to the soil-less image (f).

RESULTS

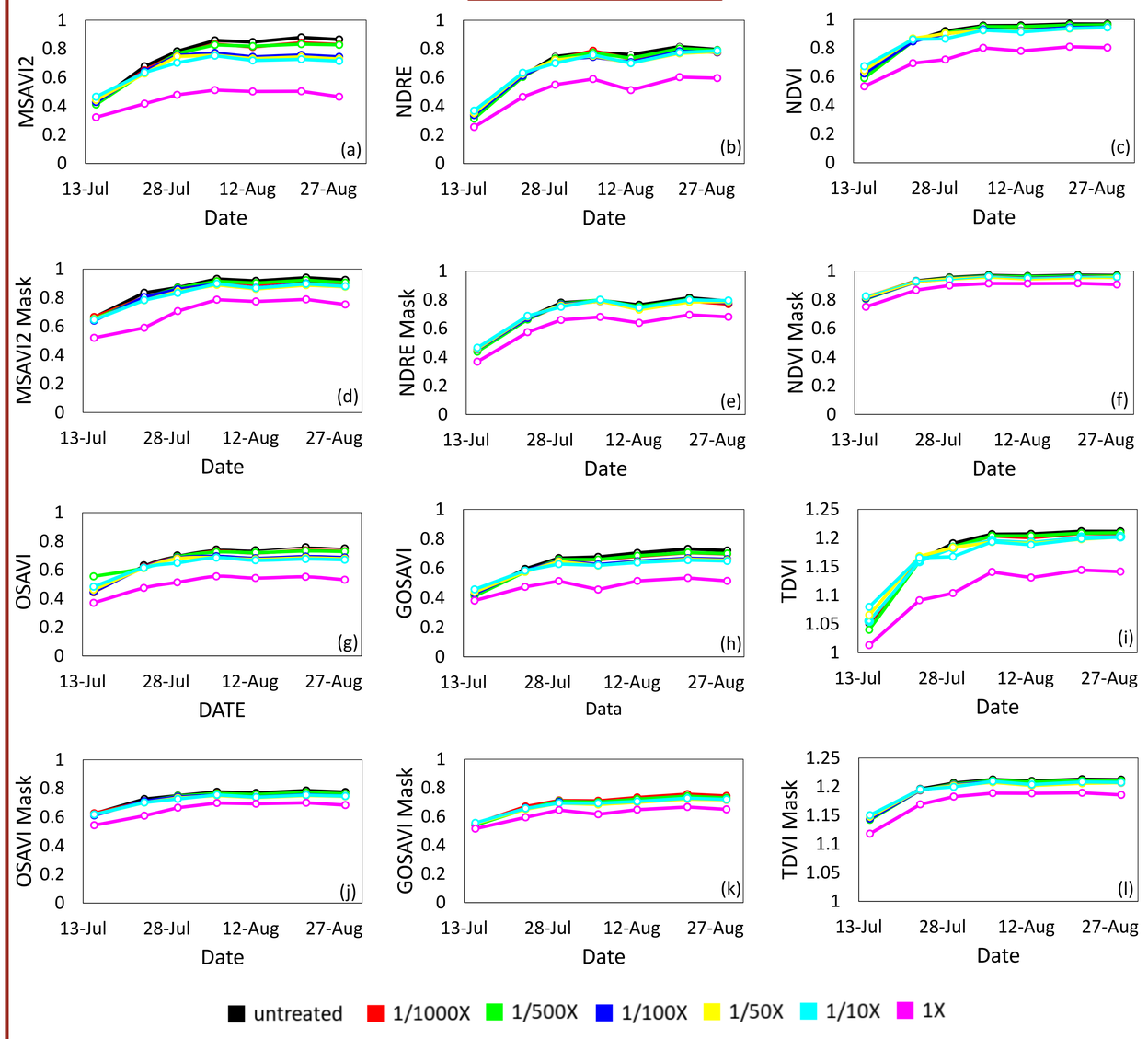


Figure 2. Graphs of the treatments from 6 through 51 days after application with MSAVI2 (a), NDRE (b), NDVI (c), MSAVI2 with a mask (d), NDRE with a mask (e), NDVI with a mask (f), OSAVI (g), GOSAVI (h), TDVI (i), OSAVI with a mask (j), GOSAVI with a mask (k), and TDVI with a mask (l).

RESULTS

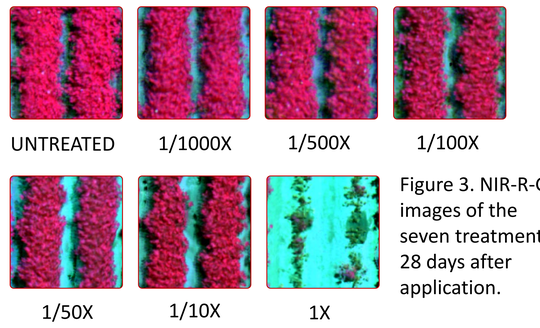


Figure 3. NIR-R-G images of the seven treatments 28 days after application.

DISCUSSION AND CONCLUSIONS

- As the cotton continued to grow after 2,4-D exposure, reflectance values increased as well as injury in the treated plots, resulting in more favorable results later in the season across all indices.
- The 1X rate of 2,4-D caused the greatest cotton injury and had the lowest reflectance values, making it the most distinguishable from other treatments.
- OSAVI with the soil background included was the only index not to differ between treatments at 6 days after application.
- The soil adjusted indices like MSAVI2, OSAVI, and GOSAVI, had greater treatment separation earlier in the season than NDVI, NDRE and TDVI.

CONTINUING RESEARCH

- Investigate more vegetation indices to find which is most sensitive to low rates of 2,4-D.
- Utilize image analysis tools to decrease spatial resolution and assess differences within indices.

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