MODERNIZING COTTON REPLANTING RECOMMENDATIONS USING UAV IMAGERY

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Abstract

When suboptimal plant stands occur, growers must decide if replanting is justified. Many factors influence these decisions including the costs of replanting, time left within the optimal planting window, prevailing temperatures and soil moisture, and the likelihood of improved success by replanting. Replanting is generally justified when 50% or more of the planted area is occupied by 3-foot skips between adjacent plants within a row (Jost, 2006). However, it is generally difficult to visually assess the percentage of planted area occupied by 3-foot skips, and very cumbersome and time-consuming to accurately measure. New advances in precision agriculture, such as the implementation of unmanned aerial vehicles (UAV) and their ability to generate high-resolution imagery are being used for a variety of applications in agriculture (Ehsani, 2013). Additionally, UAV's may allow for quicker and more precise assessments of planted areas. The objective of this study was to evaluate the performance of UAV's to traditional methods in measuring size and frequency of skips in cotton plant stands.

Research trials were conducted at three sites (Rocky Mount, Lewiston, and Plymouth NC) in eastern North Carolina during 2019. Each site included both an early and late planted trial, which were subjected to a randomized complete block design: four-row plots and four replications per site, each including various ratios or mixtures of DP 1646 and DP 493: 100%, 75%, 50%, 25%, and a 100% simulated replanting treatment, at 43,560 sd/A. Within the early planted trial at each location, planting of all treatments excluding the simulated replanting treatment were targeted at May 1st, with the simulated replanting treatment targeted for May 25th. Within the late planted trial at each location, planting of all treatments excluding the simulated replanting treatment were targeted at May 25th, with the simulated replanting treatment targeted for June 5th. Immediately following emergence, glyphosate (32 oz/A) and glufosinate (42 oz/A) were applied once in each of three consecutive weeks following emergence, to terminate all conventional seedlings, leaving natural, random skips that varied in size and frequency. The percent of planted area occupied by skips of various size and frequency were detected using a DJI Matrice 600 Pro drone and counted with Precision Hawk Ag Analytics. Using the data obtained through imagery, an algorithm was developed in R to measure distances between plants. Similarly, subsamples of 200 ft. of row were measured in each plot, for comparison. Data were subjected to ANOVA and regression analyses. Means were separated using Fishers Protected LSD at $p < 0.1$.

Most modern growers or consultants are not likely to invest the time and labor required for precise manual measurements of skips, whereas UAV assessments can be conducted on a larger scale. Results from this research suggested that UAV measurements of skips in the entire planted area were similar in precision to manual measurements of smaller subsamples. Additionally, UAV measurements of skips (size and frequency) across the entire planted area of each plot were conducted in approximately 25 percent of the time required to manually measure only a 200-ft. subsample of row. Manual measurements detected a greater percentage of planted area occupied by skips of most sizes, however it also resulted in a more frequent failure to detect skips at thicker plant stands compared to the UAV measurements of the entire planted area. For most sized skips, differences in slopes of the regression between UAV and manual measurements were observed, in that UAV measurements of skips resulting in a greater slope of regression than that of manual measurements. This suggests that measuring skips in the entire planted area using UAV imagery would likely trigger replanting at a much lower threshold than would manual measurements of field subsamples.

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References

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