BLUE PILL / RED PILL: YIELD PHENOTYPING IN A RAIN GROWN MATRIX

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Abstract

Aerial imaging of crops has become increasingly important as a tool for crop management. As analytic power and technology continues to develop and the capacity for deployment becomes better understood by producers and researchers, aerial imaging will be a commonly used on-farm and research tool. Currently, the cost of equipment, software, and personnel capable of producing meaningful output with contemporary technology can be prohibitive. While the ability to generate useful output with expensive technology is documented, the degree of relevant output that can be generated with minimal aerial imaging and inexpensive processing technology is unknown. Open source imaging software coupled with off-the-shelf drone hardware is neither cost prohibitive or difficult to obtain. We have evaluated a combination of cheap, consumer-grade hardware and open source software for its utility in estimating cotton yield in a rain-grown production setting. We employed a DJI Phantom IV drone equipped with a standard 12.4-megapixel digital for aerial imaging. Image analysis was done with OpenCV 3.3.0, an open source library containing hundreds of script-based computer vision tools and functions. Our specific implementation of the OpenCV library was through OpenCV-Python. The experiment consists of using a range of flight path parameters in conjunction with several image processing algorithms to survey a rain-grown cotton matrix that included a range of planting dates from April 3 (approximately 50 days earlier than traditional planting) through July 17 (approximately 30 days past the cut off planting date) and range of probable rainfall events based on historical data. The goal was to identify the combination of altitude, image overlap, speed, and processing algorithm most capable of predicting yield for a specific sample sites within the rainfall matrix. Ground-based landmarks were placed to identify one-meter sections of the field and to ensure that the locations of hand harvested samples were uniform across all composite images. The flight-path/ algorithm combinations produced yield estimates for our sample spaces that were plotted against actual yield values for the same space; those that most accurately predicted yield were identified. The general performance of economical drone hardware used in conjunction with open source software was documented and will be presented.