PROXIMAL SENSING CARTS: A LOW-COST ALTERNATIVE FOR FIELD-BASED HIGH-THROUGHPUT PHENOTYPING

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<u>Abstract</u>

Field-based high-throughput phenotyping (FB-HTP) is an emerging approach to characterize plant traits using proximal and remote sensing. FB-HTP will provide a way to increase plant breeding efficiency and effectiveness by characterizing plant traits in both time and space which improves understanding of dynamic genetic responses to environmental conditions. Early implementations of FB-HTP platforms have been expensive and impractical for large breeding programs. Proximal Sensing Carts (PSCs) are an option that can overcome some of the problems discovered with early platforms. PSCs incorporate proximal sensors and cameras in a similar way to high-clearance tractors and drones but are less costly, easy to deploy, and easy to transport. To evaluate this potential, the US Arid Land Agricultural Research Center in Maricopa, Arizona, has been developing, evaluating, and modifying PSCs for application in cotton breeding trials grown under hot, dry conditions since 2010. During this time four PSCs were designed and constructed. The carts are equipped with either infrared thermometers, ultrasonic transducers, spectral reflectance sensors, or RGB cameras, and were evaluated for performance, data capture consistency and quality, and application in a small upland cotton variety trial. The pros, cons, and adaptability of each PSC design and data output, including proximal sensors and RGB point clouds, are discussed.