COMMERCIAL-SCALE DETECTION, 3-D VISUALIZATION AND MITIGATION OF SOIL COMPACTION USING AIR-LAUNCHED, MULTIMODAL, AI-INFORMED SENSORS THAT ENABLE PRESCRIPTION-DRIVEN, VARIABLE DEPTH TILLAGE

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Abstract

Experts agree that soil compaction limits crop yields by 10%-20%. It follows that, in numerous studies, cotton yield has benefitted significantly from energy intensive and costly subsoiling, when that practice was compared to conventional and no-tillage systems. Using a strain gauge-equipped "smart plow," Clemson University researchers reported in 2018 that: (a) only 20% of their cotton test field required subsoiling at the recommended depth of 15 inches, (b) variable depth tillage (VDT) generated a 20% yield improvement over no tillage and, (c) "site-specific tillage operations reduced fuel consumption by 45% when compared to conventional, constant-depth tillage." In 2020, EarthOptics demonstrated a novel, scalable method for detecting, visualizing and achieving site-specific mitigation of soil compaction. Air-launched, multimodal, ground-penetrating radar and electromagnetic induction sensor payloads were mounted on ATVs, integrated with machine learning and operated at speeds up to 30 mph. These GroundOwl™ sensor payloads, aided by machine learning, detected soil compaction, i.e. soil resistance to penetration, in 3-dimensions. To visualize compaction for growers and crop advisors in (near) real time, a fully-automated, geospatial, cloud-based, interactive, visual analytic was developed. That SoilMapper™ application models soil compaction to a depth of 18 inches and, with only four mouse clicks, creates and exports a digital prescription that enables site-specific VDT in 3-dimensions. In April 2021, EarthOptics used a CNH 350 hp tractor, a Pro700 cab computer and a CNH Ecolo-Tiger 875 implement to conduct the first commercial-scale demonstration of prescription-driven VDT in cotton. Versus conventional tillage, VDT significantly increased cotton boll numbers/10ft. of row and boll numbers/plant. No statistical difference in boll numbers was observed between VDT within a 14-inch plow layer and subsoiling to a constant depth of 14 inches. With VDT, fuel consumption was lower and time savings were documented. The tandem of 3-dimensional soil compaction mapping and prescription-driven VDT are scalable precision agriculture practices that offer cotton producers attractive value propositions in the form of yield improvements, energy savings, time savings and reduced wear and tear on tillage equipment.