Development and Expansion of Conservation Agriculture Systems in California’s Central Valley

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Background
California’s Great Central Valley (CV) contains some of the nation’s most productive farms that benefit from the region’s highly developed irrigation infrastructure, well established, advanced production technologies, and a mild Mediterranean climate. The evolution of today’s mature production systems in the CV has relied largely on intensive, clean-cultivation tillage. Since 1998, however, a growing number of farmers, university, USDA Natural Resource Conservation Service, private sector and environmental group partners have worked to develop conservation agriculture (CA) alternatives for the CV that reduce soil disturbance, preserve surface residues, use cover crops to benefit soil function, reduce soil water evaporation and also decrease dust emissions. This group, the Conservation Agriculture Systems Innovation (CASI) Center, has documented movement toward broader adoption of CA systems in California across a wide variety of specific cropping contexts including dairy silage, tomato, cotton, wheat, and other vegetable production systems through its biennial surveys of different management systems. Goals of the CASI Center are 1) to increase the sustained adoption of conservation agricultural systems to more than 50% of cropping acreage by the year 2028, 2) to develop and deliver information on the economic and environmental benefits of conservation agriculture systems, 3) to partner with national and international conservation organizations and serve as a clearing house for information to promote conservation agriculture systems, and 4) to increase funding for conservation agriculture systems research, education, and adoption in California.

Results
Research conducted by CASI during this time has demonstrated a number of economic and environmental benefits that are achieved when CA practices are used including 1) tillage costs typically reduced by $40 - $150 per acre (Mitchell et al., 2012a), 2) lower fuel use (Mitchell et al., 2012b), 3) reduced PM emissions by 50 – 80% (Baker et al., 2005), 4) increased soil carbon levels (Veenstra et al, 2007), 5) lower soil water evaporation (Mitchell et al., 2012c), 5) increased irrigation application efficiency and uniformity (Submitted, Mitchell et al.), and 6) biologically-fixed nitrogen added to the soil (Mitchell et al., 2013).

Applications and Implications for Conservation Agriculture
One of the yet-to-be-realized, but potentially most impacting aspects of this locally-derived research is the ability of CA farming systems to increase water use efficiency and reduce soil water (“green water”) evaporation in the face of uncertain climate and sustained droughts. Thus, developing production techniques that increase the water storage capacity of soil--the green water availability--and the amount of green water flow that is actually transpiration--productive green water flow, which 'takes the E out of ET' and increases crop yield is an ongoing focus of CASI. Unlike other regions of the world where CA systems are now common and well developed, this potential attribute of CA has not yet seen widespread recognition although there is now a growing farm experience base that has demonstrated this benefit in specific California cropping contexts.
Experimental Approach
An important core strength of CASI is its ability to develop information on cropping systems alternatives that will enable producers to attain sustainability goals over the long term. This has involved both coordinated research-based performance evaluations of alternative CA systems, technologies, and practices, and also local and successfully implemented demonstration evaluations of CA systems.

Results and Discussion
While California farmers and researchers have successfully proven the efficacy of CA, adoption remains less than optimal. The gap between successful integration of CA practices on farms and widespread adoption highlights the need to study barriers limiting adoption. Using a combination of survey and interview methods, we also distinguished characteristics between CA adopters and non-adopters in California. Results indicated that many farmers who are not adopting CA do not see it as a viable option given the risk involved or the incompatibility of the practices in their current cropping system. In order to reduce the risk of adoption and learn how to make CA practices compatible with California crop rotations, both exchanging information and gaining meaningful experience that can be used to improve and develop these practices are needed. Extension education typically has focused on the first part of this learning process where information is exchanged from university research to farmers. Our work suggests that gaining meaningful experience with CA practices is also a large component of successful adoption. Extension programs therefore should consider how to facilitate this meaningful experience to complement the distribution of relevant, local information.

References