

Coupling automated overhead, low-pressure irrigation systems with conservation tillage: A new irrigation, crop and drainage management paradigm for the Central San Joaquin Valley?

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Executive Summary

Projections for what Central Valley (CV) agriculture will look like in the future identify water, labor, regulation and competition as major drivers. CV farmers will face powerful pressures for new, cheaper and more efficient, water-conserving cropping systems. Low-pressure overhead irrigation (center pivot and linear move), coupled with intensive and diverse, no-till (NT) planted crops, may be a “systems” means for producing high quality crops more cheaply than they are produced today. Such systems would theoretically overcome problems associated with surface or gravity irrigation across or through residues that tend to accumulate in NT fields, may conserve water resources and reduce drainage volumes over the long-term and may also considerably reduce labor, fuel and equipment costs associated with preparing fields for surface irrigation management. Our own recent advances in no-till planting systems in CV dairies and successful experiences with no-till cotton in Arizona indicate promise of these systems. In addition, preliminary information we have developed from two center pivot systems that have recently been established in the CV indicate the potential for both very significant labor and water savings with these systems relative to traditional surface irrigation systems. We therefore propose to conduct “bottom line” economic, agronomic and water management evaluations of no-till, flat-planted crop rotations under center pivot irrigation in field station and farm studies in the CV to evaluate the potential of these systems to sustain agricultural productivity in the

region. The specific hypothesis that will be tested in this proposed work is that crop yields can be maintained in an intensified NT rotation under overhead irrigation relative to today's standard systems and overall production economics and water use efficiencies of the intensive no-till system will be more favorable.

The work proposed here looks well beyond the crop production systems that dominate today and considers the major factors that might most likely determine the evolution of production systems in California in the future. Fuel costs, water and labor availability, and greater regulation aimed at natural resource conservation are likely to be major determinants of future Central Valley production systems. Automated overhead center pivot or linear move irrigation systems would, in theory, greatly reduce the need for labor, - both for irrigation system management and for intercrop tillage typically needed for surface irrigation, - and could also reduce irrigation application nonuniformities as well as drainage losses. No-till production practices require fewer tractor operations and less equipment and therefore would lower fuel needs and overall production costs. Recent research here in California has shown that "conservation tillage" systems can cut fuel use by more than 50%, and this estimate is not based on the fuller "no-till" systems that have been developed elsewhere and that are proposed here. A sizable portion of a typical Central Valley farm's budget is actually dedicated to the preparation, reestablishment and maintenance of field conditions that enable and facilitate surface, or gravity irrigation (chopping residues from previous crops, disking the soil, chiseling, disking, listing beds, cultivating, creating and maintaining tailwater return systems). Under low-pressure, overhead irrigation systems, the labor requirements for such operations would be greatly reduced or even eliminated. Soils under no-till production systems may also store more water than conventionally tilled soils (Beck, 2002; Tanaka and Aase, 1987). In addition, soils with stubble cover reduce wind velocities and temperatures at the surface, which reduces evaporation from the soil surface. Coupling no-till and surface residue preservation with overhead, low-pressure irrigation may thus be a means for conserving water and improving the production efficiencies in CV cropping systems, however both the production mechanics and related research base is currently lacking that might substantiate this claim. Finally, because dust emissions associated with tillage are generally and directly related to the number of tractor operations in a given cropping system (Baker et al., 2005), widespread no-till production would likely have a very significant positive impact on air quality. In sum, the potential "systems level" benefits that might accrue from the integration of production and management approaches we propose here could conceivably be quite large and extremely significant both in terms of economics and resource conservation to Central Valley producers in the future. Because of these potential benefits, we hypothesize that the integration of overhead irrigation systems with conservation tillage practices will become considerably more common in the CV during the coming years. Indeed, the farmer partners who will work with us on this proposed project are committed to overhead systems and are installing several more of them in the very near future at their farms, but they currently need far better, locally-derived management information than is now available. There is, however, no research under way in California that is evaluating the "systems" potential of this approach, nor is there a well-developed experience base from which to derive management recommendations. We therefore request support from the WRC to enable the conduct of cropping systems comparisons of low-pressure overhead irrigated no-till systems and standard, surface irrigated systems in the San Joaquin Valley.