PRECISION IRRIGATON & CONSERVATION TILLAGE: A PLAN FOR IMPROVING FORAGE PRODUCTION SYSTEMS

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ABSTRACT

Key Words: center pivot irrigation, conservation tillage, overhead mechanized irrigation

INTRODUCTION

Decreased and more variable water supplies are expected in California's San Joaquin Valley (SJV) in the future and are likely to hit the region's forage production sector particularly hard. Improving crop water productivity through innovative irrigation management and drought-resilient tillage and residue management techniques that have been pivotal to agricultural sustainability in other parts of the world may be increasingly imperative in this region if producers are to avoid uneconomic reductions in production due to shrinking water availability. Recent technological advances in precision overhead irrigation systems that can be readily coupled with water-use-efficient tillage and residue management techniques and regulated deficit irrigation approaches may be a 'cropping systems' means for sustaining productivity and preserving the competitive agricultural capacity of forage systems of the region.

Overhead irrigation is currently the most prevalent form of irrigation nationwide (NASS, 2010), and recent surveys in Nebraska, a region similar to California in terms of the general need for irrigation for crop production, indicate that precision overhead systems and recent technological advances in overhead equipment are now rapidly and completely replacing gravity irrigation because of the ability that these systems provide to apply precise water amounts and to increase productivity (Pfeiffer and Lin, 2009). Perhaps surprisingly, however, overhead irrigation is currently estimated to be used on less than 1% of CA's cropland (NASS, 2010). While there are over 80,000 pivots in NE, fewer than 350 are in use today in CA (NASS, 2010). The possible benefits of overhead irrigation for SJV systems have been recognized by a number of farmers in recent years throughout the area (Warnert, 2011) as a means for sustaining profitability, increasing competitiveness, and preserving the productive capacity of the region, however, no locally-derived information has been developed to guide and inform forage producers on how to use overhead systems to achieve greatest advantage.

Three SJV crops that may particularly lend themselves to overhead irrigation are the forage crops, corn, alfalfa and sorghum. Alfalfa is currently the single largest agricultural water user in California due to its large acreage and long growing season (Hanson et al., 2007). While there has been some movement toward drip in alfalfa, it is still a largely surface-irrigated crop (Personal communications, D. Munk and D. Putnam). However, no work is being done currently and locally to develop information on the potential beneficial applicability of overhead deficit

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irrigation for these crops and farmers have expressed to us difficulties in conducting this sort of investigation at their farms for a variety of reasons.

Overhead irrigation is currently estimated to be used on less than 1% of California's crop acreage. Very recently, however, within the past five years, there has been a dramatic increase in the number of overhead irrigation systems that have been introduced into the Central SJV. Overhead mechanized irrigations systems have been generally shown to have higher application uniformities and efficiencies than surface systems. Higher application efficiencies can lead to reduced water requirements. In irrigated areas such as the Ogallala Aquifer or the south-central region of Brazil, where overhead irrigation has rapidly expanded, its use is often coupled with various sorts of conservation tillage (CT) practices because furrows that permit surface water movement and that require considerable intercrop tillage are no longer required. Direct-seeding or no-till planting is thus enabled in overhead systems. After sustained CT production, soils may store more water than conventionally tilled soils due to the maintenance of macropores. In addition, soils with stubble cover also reduce wind velocities and temperatures at the surface, which may reduce evaporation from the soil. 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 SJV cropping systems, and also for providing greater cropping flexibility to rotations, however both the production mechanics and related research base are currently lacking that might substantiate this claim.

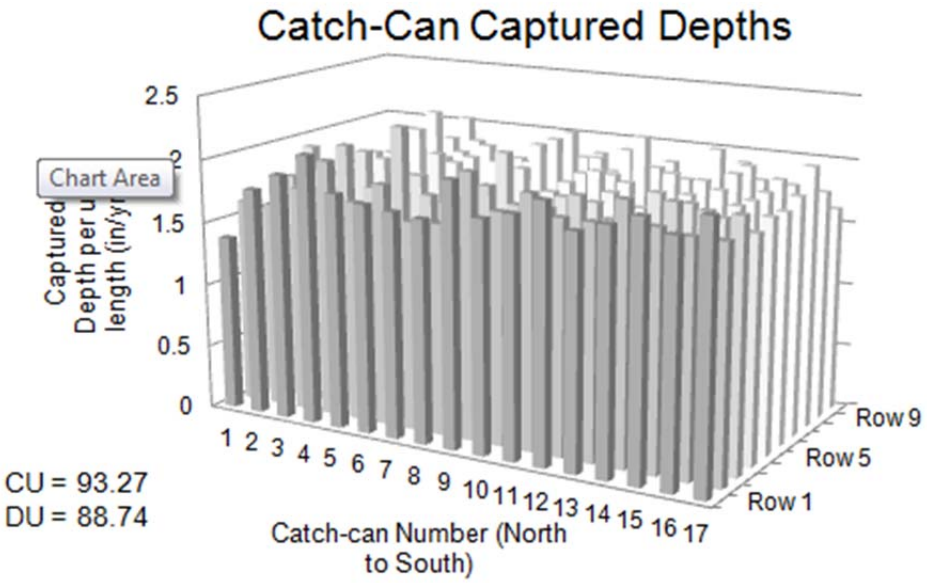
Conservation tillage provides significant means for reducing costs, dust emissions, and fuel use in many crop production systems. We recently demonstrated that costs can be reduced by 14 – 18% when using CT cotton planting and postharvest stalk management systems, while yields were maintained. No-till and strip-till crops are successfully produced in the South, the Midwest and in Brazil. No-till, flat-planted late-season cotton has been produced profitably for several years in AZ. No-till and strip-till forage production has been successful in a growing number of SJV dairies. These experiences indicate that these CT production techniques are feasible and could ultimately become a viable option for the SJV if focused and intensified research and farm innovation are dedicated to making the approaches successful and profitable.

In order to effectively "couple" highly efficient irrigation systems such as drip and overhead with the use of cost-cutting CT practices, however, new production paradigms are needed to optimize the performance of the merged technologies. Our goals in this world have been to evaluate forage production systems that couple reduced tillage techniques with precision overhead irrigation to lower production costs, increase water use efficiency, and to improve soil health or function over the long-term. To achieve these goals, we have first worked with several forage farmers to support their efforts to develop successful reduced tillage systems for both corn and winter small grains.

When this farm work was started in the early 2000's, less than 1% of corn silage acreage was seeded using either strip-tillage or no-tillage. Since then, biennial surveys of our CASI (Conservation Agriculture Systems Innovation) Center indicate that the largest change in conservation tillage acreage from 2004 – 2012 is found in the amount of corn silage acreage that now uses strip-tillage. In 2004, there were only about 490 acres of summer silage corn using strip-till, while in 2012 over 181,000 acres throughout the San Joaquin Valley region had

adopted the use of this form of conservation tillage. A strip-tillage and planting service is now available in the San Joaquin Valley that provides expert support to farmers who are interested in learning more about these production system alternatives and several experienced conservation tillage farmers are available throughout the region to share their knowledge with these techniques.

To characterize the application uniformity of the overhead system that we have used at the University of California's West Side Research and Extension Center in Five Points, CA, we conducted a series of catch can determinations and from these calculated Christiansen's Coefficient of Uniformity (CU). A CU value of 93.27% was determined.



Findings from these studies that have attempted to couple overhead precision irrigation and conservation tillage technologies will be highlighted in more detail in the accompanying oral presentation at the 2014 Alfalfa Symposium in Long Beach, CA on December 11.

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