SUSTAINABLE AGRICULTURE FARMING SYSTEMS PROJECT
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Economic performance of sustainable farming practices

by Karen Klonsky and Pete Livingston

One of the major goals of the Sustainable Agriculture Farming initiatives at UC Davis is to provide information about the feasibility of adopting conservation tillage and cover cropping at the farm level. The project includes two tillage schemes: standard tillage (ST) and conservation tillage (CT), and three farming methods: conventional, organic, and winter legume cover crop. All three production methods are used in combination with both tillage systems for a total of six alternative systems. Each of the six systems is used in the trials to grow both processing tomatoes and field corn. This article will examine the profitability of the alternative farming systems under investigation at SAFS based on the 2004 cropping season results.

photo by Sam Prentice

SAFS research assistant Aaron Ristow checks datalogger monitoring surface runoff in vetch cover crop plot.

We calculated the costs and returns for each of the alternative farming systems and each of the crops based on the calendar of operations used in the trials and the yield results. The costs per acre are based on the equipment used and the time it would take in a farm setting rather than a field trial. We used the input rates for the trials along with input costs provided from local suppliers. The prices received are those typical for the area in 2004. We calculated the organic system revenue both with and without organic premium prices realized by local growers. The profitability of each system equals the revenue minus the costs. A positive return indicates that the system is economically sustainable at least in the short run.

Tomato. The 2004 tomato yields were disappointing for all systems, falling below the Yolo County average. In all cases the standard tillage systems were higher-yielding than the conservation tillage systems (Table 1). At a price of $50.10 per ton the standard tillage systems garnered $179 more per acre for the conventional system, $46 more for the winter legume cover crop system, and $372 per acre more for the organic system at conventional prices and $475 more at the higher organic premium price of $65 per ton (Table 1).

These higher profits equal the break-even cost savings required to make the profit from the conservation tillage systems equal to that of the standard tillage systems. For example, if conservation tillage results in a savings of more than $179 per acre for the conventional system then it is more profitable to use CT because the reduction in costs is higher than the loss in revenue. On the other hand, if the cost saving from CT is less than $179 then it is more profitable to use standard tillage because the loss in revenue reduced profit more than the cost savings increases profit.

For the conventional system the cost savings from conservation tillage was only $13 for the conventional system and $20 per acre for the cover crop system, well below the break-even thresholds (Figure 1). The savings came from reduced weed control costs and reduced residue management costs (Figure 1). The ground prep costs were actually higher for CT than

SAFS field day

Welcome to the Spring 2005 Sustainable Agriculture Farming Systems (SAFS) newsletter. The SAFS project began in 1988 at the main UC Davis campus and moved to a permanent site at UC Davis' Long-Term Research in Agricultural Systems (LTRAS) experiment fields west of campus in 2003. We are pleased to continue working with the statewide UC Sustainable Agriculture Research and Education Program (SAREP) on outreach, including our newsletter, Web site and other products.

In this issue we address the profitability of the alternative farming systems we're investigating, based on the 2004 cropping season results. We also provide information on conservation tillage and cover cropping's effect on the amount and quality of water from winter runoff and summer irrigation return. The articles continue our efforts to provide useful information on economically and ecologically sustainable research and management practices for California growers. Please join us for our June 23, 2005 field day for further updates on our research (details back page).

—Will Horwath

ST because of the extra operations used to manage the beds due to the high amount of residue left from the preceding corn crop. For the organic system the production costs were actually higher for CT than ST due to higher hand weeding costs.

Corn. The yields for the conventional systems for corn were above the Yolo County average in 2004, but the organic and winter legume cover crop systems fell far below the county average for both the conservation tillage and standard tillage methods (Table 1). The constraints of cover crop management in the winter legume and organic systems delayed planting these systems, which most likely impacted potential yield. In all cases the standard tillage systems yielded about 400 pounds per acre more than the analogous conservation tillage system for a difference of $18 per acre (Table 1). At a price of $88.52 per ton, the difference is $18 per acre. For the organic system at the premium price of $140 per ton, the CT system showed higher revenue of $26 (Table 1). It is important to keep in mind that, in general, processing tomatoes are a much higher grossing crop than field corn. Therefore, profit maximizing decisions are based primarily on the performance of the tomato crop and not the corn crop.

The savings from conservation tillage was much higher for corn than tomato. The savings were due to a decrease in ground preparation, weed control, and residue management. The savings were $145 per acre for the conventional system, $73 per acre for the organic system, and $61 per acre for the winter legume cover crop system (Figure 2). However, the conventional system was the only one to show a positive return above operating costs. In this case the cost savings from conservation tillage of $145 per acre was higher than the revenue reduction of $18 per acre for a net increase in profit of $127 per acre (Table 1). Both the organic system and the winter legume cover crop system showed a loss with conservation tillage and standard tillage, although the loss was greater under standard tillage.

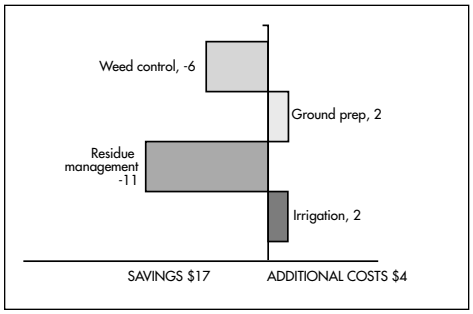

Figure 1. Comparison of Conventional Tomato Costs with Conversion to Conservation Tillage 2004

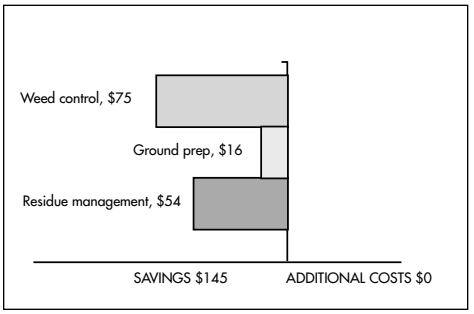

Figure 2. Comparison of Conventional Corn Costs with Conversion to Conservation Tillage 2004

Conclusion

The analysis clearly demonstrates the potential for CT to decrease operating costs for both processing tomato and corn. The cost savings in 2004 were greater for corn than tomato because of the extra operations used to shape the tomato beds before transplanting. Also, the organic tomato system using conservation tillage required additional hand weeding. Despite these encouraging findings, CT will not be attractive to growers unless yields are comparable to those under standard tillage. Therefore, the challenge for the coming season will be, first and foremost, to modify the systems to improve yields without compromising the spirit of conservation tillage. We are exploring modifications to optimize yield and/or economics in the winter legume and organic systems. These include evaluating varieties to overcome planting date issues, optimizing CT to reduce field passes and soil disturbance, and determining innovative weed management practices.

Table 1. Costs and Returns 2004

	Standard Tillage				Conservation Tillage				CT minus ST			
	Conv	Org	Org+	WLCC	Conv	Org	Org+	WLCC	Conv	Org	Org+	WLCC
TOMATOES												
Yield (tons/A)	29.5	31.3	31.3	27.3	26	24	24	26.4	-3.5	-7.3	-7.3	-0.9
Price/ton ($)	51	51	65	51	51	51	65	51	0	0	0	0
Gross returns ($/A)	1,505	1,596	2,035	1,392	1,326	1,224	1,560	1,346	-179	-372	-475	-46
Operating cost ($/A)	968	1,177	1,177	1,042	955	1,350	1,350	1,022	-13	173	173	-20
Net returns above operating costs ($/A)	537	419	858	350	371	-126	210	324	-166	-545	-648	-26
CORN												
Yield (tons/A)	6	2.4	2.4	2.1	5.8	2.2	2.2	1.8	-0.2	-0.2	-0.2	-0.3
Price/ton ($)	90	90	140	90	90	90	140	90	0	0	0	0
Gross returns ($/A)	540	216	336	189	522	198	308	162	-18	-18	-28	-27
Operating cost ($/A)	429	523	523	406	284	450	450	345	-145	-73	-73	-61
Net returns above operating costs ($/A)	111	-307	-187	-217	238	-252	-142	-183	127	55	45	34

Are alternative agricultural management practices right for water runoff?

by W. R. Horwath, A. Ristow, and Z. Kabir

One of the main goals of our sustainable agriculture efforts at UC Davis is to promote "best management practices" (BMPs) to California growers by altering existing practices and implementing new ones to mitigate and improve runoff water quality. The Sustainable Agriculture Farming Systems (SAFS) project team has 16-years experience working with alternative agricultural practices in furrow-irrigated row crop production in the Central Valley. Our long-term research plots have been invaluable for quantifying interactions between farm systems (e.g., organic vs. conventional) and agronomic management practices and decisions. A unique aspect of our research is to collaborate with area growers to design and evaluate our research. The extension of research plot work to grower fields provides a mechanism to validate and extend our results to the larger field scale. Conservation tillage (CT) and winter cover cropping (CC) are alternative management practices that are proposed to reduce runoff and minimize nutrient and sediment losses. These practices have been widely adopted in the U.S. in the East and Midwest. The fact that CT and CC are working in other geographic regions does not mean it will work equally well in California's Mediterranean climate, which is one of the reasons the adoption of these practices in California has been slow. Insufficient research has been done on the integration of CT and CC practices into existing practices, and on their effectiveness at mitigating pollutants and runoff loads. California growers cite this as the primary reason for their low adoption rates: lack of successful local examples.

photo by Z. Kabir/A. Ristow

Will Horwath, SAFS principal investigator, and researcher Sam Prentice (r) install storm-runoff monitoring equipment in a UCD test plot.

Conservation Tillage in California

Large-scale adoption of CT practices in the U.S. began in the Midwest. This was done primarily to reduce soil losses from water and air erosion, and retain water in the soil profile in drier areas during fallow periods. Over the past four decades, CT in the Midwestern U.S. has increased by 300 percent. In contrast, by 2004, less than five percent of California Central Valley growers were practicing CT.

UC Cooperative Extension defines CT as a farming practice that leaves more than 30 percent of the crop residue on the soil surface or reduces tillage passes by at least 40 percent. Typical tillage systems used in California incorporate most crop residue into the soil to facilitate planting and furrow irrigation. There are many reasons why CT is not being adopted in California. Compared to Midwestern agriculture, California has a diverse system of irrigated crops. The development of CT practices requires developing individual management practices for a wide variety of crops grown in California. This is a major challenge to California growers compared to the Midwest where the CT learning curve is less steep because only a few crops are grown. In California, will deep tillage be necessary to allow water penetration and leaching of salts? Will maintaining residue on the soil surface interfere with furrow irrigation? Will the reduction in in-season cultivation of weeds increase herbicide use? Will changes in residue management require reassessment of fertilizer recommendations? Will runoff water contain higher dissolved organic carbon or herbicide levels under CT and CC? These questions require more research.

Economically, CT provides benefits by reducing labor, lowering fuel consumption, and decreasing capital investment in machinery. Agronomically, CT increases organic matter, enhances water infiltration and improves soil tilth. CT can minimize environmental impacts by reducing wind erosion and improve water infiltration. The challenges of implementation seem daunting to California growers; our research will assess the potential economic, agronomic, and environmental benefits of CT.

Cover Cropping in California

As with CT, the implementation of cover crops has lagged behind other parts of the country. CC has been adopted in less than five percent of the row crop area in California. This is primarily due to issues of delayed field entry in the spring, additional production costs, build-up of noxious weeds, and reassessment of fertilizer recommendations. All these factors can negatively affect the economic viability of farm operations. Increased irrigation water use due to enhanced infiltration may translate into decreased water use efficiency as in systems using CT. It is hoped that California growers will begin to adopt CC practices as more research continues to demonstrate its benefits, which include increasing soil fertility, interrupting pest cycles and decreasing winter water runoff.

Research Needed

The adoption of CT and CC in the Central Valley requires research into the integration of these practices into California's distinctive climate. Questions remain about how to maintain the state's phenomenal yields, which have required considerable inputs such as intensive tillage, fertilization, and furrow irrigation. Increased water infiltration during summer irrigation as a result of the positive influence of CT and CC practices on soil properties will reduce

irrigation water use efficiencies. This may require additional irrigation water in the future and thus compete with population growth and environmental needs. Our research is addressing these issues by examining the effectiveness of CC species for fertility and runoff abatement and determining tillage methods to reduce soil disturbance and enhance profitability. Specific crop rotations using both traditional crops and new crops may be required to optimize the adoption of CT and CC. The interfacing of subsurface drip irrigation with CT and CC practices has not been examined and requires further development. These are some of the questions and challenges UC Davis investigators are addressing on research and grower-collaborator fields in their efforts to establish BMPs that reduce inputs and minimize winter runoff while enhancing farm profitability.

Conservation tillage field day, Thursday, June 23, 2005

Join us for field tours, field demonstrations and a panel discussion of growers and farm advisors at the SAFS site.

Location: Russell Ranch, approximately seven miles west of the UC Davis campus on Russell Blvd., ½ mile west of County Road 95.

Sign-in/registration starts at 7:30 a.m. with program beginning at 8 a.m. Events conclude at 2:30 p.m.

Pre-register by June 16; $10 general / $5 students (lunch and refreshments included).

More information at the SAFS Web site http://safs.ucdavis.edu/, or contact Z. Kabir at (530) 754-6497, Kabir@ucdavis.edu.

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