BENEFITS OF DIVERSIFYING THE CORN-SOYBEAN ROTATION: Data from WICST 1995-2003

Janet Hedtcke[1], Josh Posner[2], and Jon Baldock[3]

INTRODUCTION

Since the mid-20th century, farmers have become more specialized, resulting in less diverse and higher input cropping systems. However, marginal profits, increasing pest pressure, and growing concern for pollution hazard have renewed interest in diversifying cash-grain rotations. As part of the Wisconsin Integrated Cropping Systems Trial (WICST), we compared 3 cash-grain systems with different levels of crop diversity and inputs for 9 years and compared them in terms of production, profitability and environmental impact.

MATERIALS AND METHODS

Based on early results from the WICST, which began in 1989, a 'Chemlite' system was initiated in 1995 for comparison to the existing cash grain systems of continuous corn (c-c-c), and a no-till corn-soybean system (c-sb). Chemlite is a corn-soybean-winter wheat with red clover system (c-sb-w/rc) with half the N fertilizer and pesticide inputs as the other systems. The soybeans were drilled in narrow rows in the no-till system and planted in wide rows in Chemlite to allow row cultivation. Red clover was drilled in the wheat in early spring. All plots were 0.7 acre and field-sized equipment was used. Management inputs and outputs, and commodity prices have been recorded each year. Soil fertility levels and soil nitrates were monitored from annual fall soil sampling.

The experiment was set up with two replicates in a randomized complete block. Each phase of each system existed each year during the 9-yr trial to encompass different environments and weather. All effects in the model are fixed except year and replicate, which are random. To compare corn and soybean phases, 95% confidence intervals were calculated.

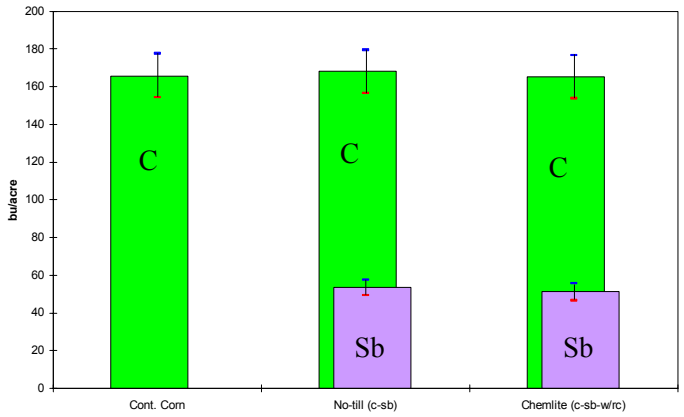
The Crop Rotations Options Program (CROP) software (Baldock et al., 1998) was used to determine net returns (to labor, capital, and management). Net returns were calculated on a system basis. A 1000-acre farm was used in CROP and yearly input prices (seed, fertilizer, herbicide etc.), yields, and commodity prices (including straw sales) were entered for each system. Harvest-time commodity price (October price without storage option [WI Ag Stats, 2004]) was used across systems without any governmental price supports. We used RUSLE2 at various slope steepness and lengths to compare each system's predicted soil erosion.

RESULTS

There were no YEAR X SYSTEM interactions for crop yield so system means are presented. Corn and soybean yields were not significantly different among the systems averaging 166.9 and 52.5 bu/a, respectively (Fig. 1). Wheat grain and straw yields in Chemlite were above the local county average (data not shown).

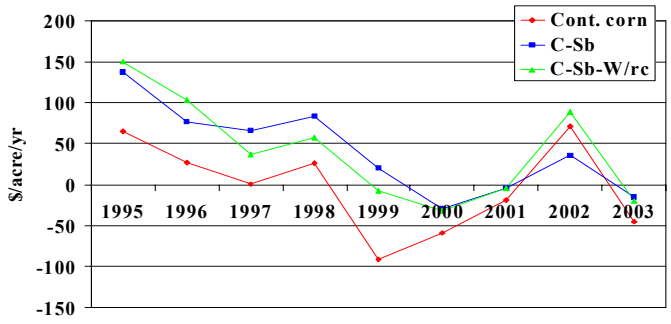
[1] Research Specialist, UW-Madison, Agronomy Dept. jlrieste@wisc.edu
[2] Professor, UW-Madison, Agronomy Dept., jlposner@wisc.edu
[3] AGSTAT, Verona, WI agstat@tds.net

Fig. 1. Corn and soybean yield comparison across systems with 95% confidence interval (1995-2003 avg.)



The 9-yr. average net return was very similar between no-till c-sb ($45/a/yr) and Chemlite ($41/a/yr), both significantly higher than continuous corn ($3/a/yr). Note the precipitous trend in net returns for all systems, which was mainly due to declining commodity prices during the time of the study (Fig. 2).

Fig. 2. Net Returns ($/a/yr) on each system over 9 years.



Due to the annual use of starter fertilizer, the continuous corn plots had higher STP values (89 ppm) than the other systems (58 ppm). Fall soil nitrates, which could potentially leach into the ground water, were always highest under continuous corn, over twice that of typical

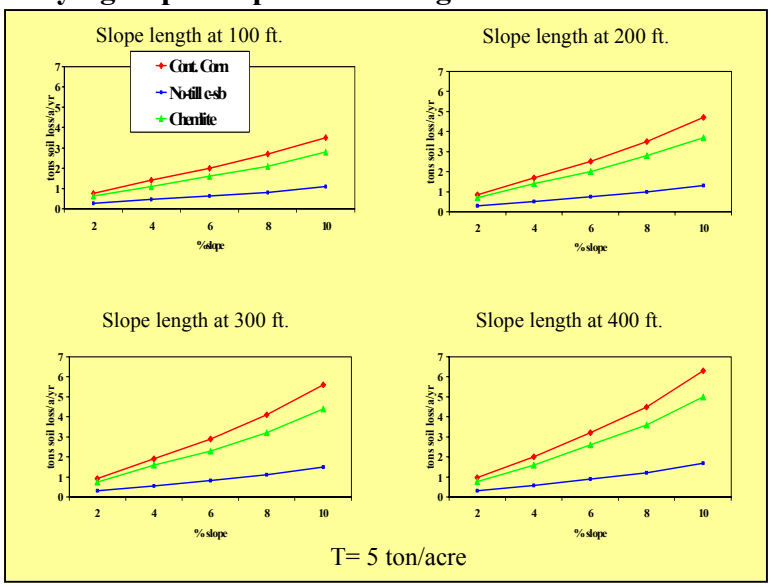
'background' nitrate levels of 50 lb/a to a 3-ft. depth. Chemlite was 41 and 23% lower than continuous corn and no-till c-sb, respectively (Fig. 3). The wheat phase in the fall and winter on a third of the farm helps to hold the nitrate in place. Furthermore, the red clover green manure reduces the use of chemical fertilizer in the following corn phase.

Fig. 3. Fall soil nitrates in top 3 ft. of soil in each system (1999-2003 avg.)

System	lb NO_3^--N/a	95% CI
Continuous corn	107.4	89.6 to 125.2
No-till corn-soy	82.5	65.2 to 99.8
Chemlite corn-soy-wheat/red clover	63.8	46.0 to 81.6

Soil loss was well under 'T' (T=5 T/a/yr) for the no-till c-sb on all 'farmable' slopes (Fig. 4). However, due to repeated annual tillage, the conventionally tilled systems should not be done on steep slopes longer than 300 ft. because soil loss approaches or exceeds 'T'. The continuous corn system had higher soil loss than Chemlite in all scenarios tested because the wheat and red clover cover crop provided soil protection in a third of the system. No-till methods can be added to Chemlite to further reduce soil erosion on steep slopes.

Fig. 4. Predicted soil loss by RUSLE2 on the 3 systems at varying slope steepness and lengths.



CONCLUSIONS

This research shows that expanding grain rotations beyond monocropping corn is advantageous from economic and environmental perspectives. Net returns were lowest for continuous corn. Soil test P remains excessively high under continuous corn. Soil loss was always CS1>Chemlite>CS2. Increasing from two crops to three also has certain environmental advantages such as reduced nitrates and it is still economically competitive.

CITATIONS

Baldock, J.O., J. L. Posner, D. Fisher. 1998. Crop Rotations Options Program. Software University of WI, Madison, WI.

RUSLE2. http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

WI Agricultural Statistic Service (DATCP, USDA), 2004.