SOIL HEALTH AND YIELD STABILITY: SUMMARY OF LITERATURE ANALYSIS

INTRODUCTION

Farmers' investments are put at risk by extreme weather events. Both drought and heavy precipitation have increased in frequency since about 1980 and are predicted to continue increasing throughout this century.

Increasing a soil's organic matter has been shown to increase its available water holding capacity, water infiltration rate, and aggregate stability, while reducing erosion and nutrient losses through runoff. This has the potential to improve a soil's resilience to extreme weather, allowing farmers to reduce their risk of economic loss.

We analyzed the scientific literature to summarize the impacts of soil health promoting practices on economic risk. Because little economic information was available, we assessed economic risk by calculating yield variability from year-to-year. More than 100 studies were found that provided enough data to allow us to assess the effect of soil health management systems and practices on yield variability.

WHAT WE FOUND

No clear relationship was found when evaluating the impact of no-till or cover crops on year-to-year yield variability. Some studies showed yield was less variable, while others showed yield was more variable using no-till or cover crops compared to a respective control. This does not mean that an individual farmer will not see greater yield stability and reduced economic risk using no-till or cover crops on his/her particular farm. In fact, many farmers are reporting these benefits. It does mean, however, that more research is needed to understand why these practices are associated with more stable yield in some studies and less stable yield in others. Many factors may influence those relationships.

We then turned our focus away from the practice, and to the soil. We found eight studies that provided enough data to allow us to evaluate the effect of adding organic matter to soil on yield and yield variability in corn. In each study, fertilizers were added to meet crop needs and minimize the possibility that a difference in yield reflected a difference in available nutrients. Studies were conducted in precipitation zones ranging from 21 to 57 inches per year, on a wide range of soils, and for periods ranging from 5 to 32 years.

As shown in Table 1, corn yield was less variable from year-to-year when organic matter was added to the soil in 5 out of 8 studies evaluated. Average corn yield was also greater when organic matter was added in those same studies. While this may reflect the benefits of higher soil organic matter, the data are hardly conclusive.

From these results it appears that although practices selected to improve soil health in general, and soil organic matter in particular, can reduce yield variability and therefore economic risk; these results are not universal. Significant work remains to understand these relationships and the additional variables influencing the results before a more definitive conclusion can be made.

TABLE 1.

Average yield and yield variability for corn with and without organic matter amendments.

Study #	Soil Texture	Organic Matter Amendment Source	Annual Precip. (in./yr.)	# Years	Average Yield (bu. / ac.)		Year-to-Year Variability* (% of Average Yield)	
					Control	Organic Matter Added	Control	Organic Matter Added
1	(unreported)	Chicken manure	24	32	55	102	37	25
2	Clay loam	Hog manure	49	15	55	80	37	25
3	Sandy loam	Poultry litter	52	9	110	117	30	25
4	Loam	Wheat straw + cattle manure	57	15	119	156	28	26
5	(unreported)	Cattle manure	25	15	96	102	25	24
6	Silt loam	Dairy manure	29	8	127	119	8	8
7	Silt loam	Hog manure	23	5	115	115	12	14
2	Clay loam	Hog or cattle manure	21	15	142	142	18	22

* Year-to-year variability is expressed as a coefficient of variation (CV). This is calculated as year-to-year fluctuation in yield (as a standard deviation) as a percentage of average yield. Larger values indicate higher yield variability.

STUDIES REFERENCED IN TABLE 1:

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