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Soil Fertility Paradigms Evaluated through Collaboration On-farm and On-station

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Abstract
A "paradigm" is a way of interpreting and making sense of the world. As such, our views on soil fertility are coherent with our interpretation of the scientific process and science institutions, and perhaps our feeling about the place of agriculture in the larger scheme of things. In agriculture today, two contradictory approaches to soil fertility uneasily coexist – the cation ratio paradigm (CR) and that referred to as "sufficient level of available nutrients" (SLAN).

Disciplines
Agricultural Science | Agriculture

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Introduction

A "paradigm" is a way of interpreting and making sense of the world. As such, our views on soil fertility are coherent with our interpretation of the scientific process and science institutions, and perhaps our feeling about the place of agriculture in the larger scheme of things. In agriculture today, two contradictory approaches to soil fertility uneasily coexist – the cation ratio paradigm (CR) and that referred to as "sufficient level of available nutrients" (SLAN).

There is little communication between the two camps; they use different terms and conceptualize fertility differently. SLAN proponents, and this now includes all of the U.S. land grant universities, concern themselves with whether the soil contains enough of each nutrient in forms that are available to the crop. In contrast, the CR approach looks not at the gross amounts of available nutrients but the proportions in which they are represented on the soil cation exchange. It is the farmer who is forced to integrate these two information streams and make the financial judgements required in farm management.
Our objectives in this study were:

1. To initiate a process, one involving stakeholders on both sides of the question, to compare the economic and agronomic consequences of two contrasting philosophies of soil fertility, termed here the sufficiency (SLAN) approach and the cation ratio (CR) approach, and
2. To implement a series of side-by-side comparisons of the two management styles, with both approaches accurately and credibly represented.

Materials and Methods

The Armstrong Farm is one of six private farms and two Iowa State University outlying farms that are involved in the study. In the spring of 1999 fertility treatments based on soil tests done in the fall of 1998 were implemented according to the two paradigms. This included the counter-intuitive practice of transporting dolomitic limestone to the western Iowa sites and calcitic limestone to the eastern Iowa sites. Field-scale plots were established in order to enable farmer-participation in harvesting and to better represent conditions in which these two approaches are used. We hope to continue the study through 2001.

At each site approximately six replications of two treatments are implemented. Amendments, representing the CR and SLAN approaches, vary with the soil analysis and the farming preferences of the producer.

Amendments applied at Armstrong:

	1999		2000	
	CR	SLAN	CR	SLAN
$CaSO_4$	yes	no		
$ZnSO_4$	yes	no		
18-46-0	yes	yes		
$CaCO_3$_$MgCO_3$			no	yes
$CaCO_3$			yes	no

The project monitors the following crop and soil quality parameters in the two comparison

systems: leaf tissue (12 nutrients); grain yields and moisture; population; grain (crude protein, crude fat, crude fiber, ADF, TDN, net energy, and five minerals); biomass of broadleaf and grassy weeds; soil aggregate stability; soil particulate organic matter and microbial biomass; soil P_1, K, Mg, Ca, S, Zn, Mn, Fe, Cu, B, OM, pH, buffer pH, and corn nitrogen status through leaf chlorophyll, the late spring soil nitrate test; and the end-of-season stalk nitrate test.

Results and Discussion

Treatments were imposed for the first time in 1999. Second year data are still being analyzed; therefore both economic and agronomic outcomes must be viewed tentatively. In 1999, per-acre expenditure for amendments (including a $25 per ton delivery charge) was $48.66 in the CR treatments and $10.12 in SLAN treatments, a difference of $38.54 per acre. In 2000, there differences that appear in one parameter or another do not constitute trends. Results should be interpreted with caution, however, because materials costs must be pro-rated over the period of their effectiveness and because any differential effects on soil and crop quality may not be apparent in the short term.

were no spring expenditures for amendments, but in fall, 2000, lime applications cost $75.38 in the CR treatments and $54.77 in SLAN treatments, a difference of $20.61.

No statistically significant crop yield differences were evident in either year. Feed analysis of the 1999 corn crop showed a significant increase in magnesium (P>.025) and a tendency for higher crude protein (P>.085). Leaf analysis of 2000 soybeans showed a tendency for higher leaf nitrogen (P>.055) and lower zinc (P>.072) in the SLAN treatment. Fall 1999 soil tests showed higher zinc (P>.026) and sulfur (P>.005) in the CR plots. The other sites in the study have also produced no consistent differences between the treatments.

Data are still being analyzed for both the 2000 and the 1999 seasons. Lacking trends in crop, soil, or economic parameters, the occasional

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