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Are Farmers Reaching Yield Potential In Corn?

Research is demonstrating otherwise, showing a large gap remains between average corn yields currently achieved by farmers and the yield potential ceiling.

Summary: *Managing at high yield levels creates large sinks for carbon (C) and mineral nitrogen (N), thereby providing the prerequisite for sequestering atmospheric carbon dioxide (CO_2) and avoiding large nitrous oxide (N_2O) emissions that could result from inefficient use of soil or N fertilizer. The N credit associated with corn/soybean rotations appears to be the result of soil N exploitation. Positive change in soil quality and system level resource use efficiency can be achieved through intensification. Increase in C inputs to soil must also be accompanied by N additions to enhance indigenous N supply. In our research we have demonstrated positive changes in indigenous soil N supply with such intensification, which translates into substantial yield responses and improvements in N-use efficiency (NUE).*

Meeting the projected global demand for food and fuel from corn production systems while conserving natural resources and improving environmental quality can only be achieved by intensification of existing corn systems. We know there remains a large gap between average corn yields currently achieved by farmers and the yield potential ceiling that can be exploited through improved crop management. Since 1999 we have been experimenting with optimizing corn management systems to exploit corn yield potential. To date, our experience has shown that considerable yield increases are realized by choosing the right combination of adapted varieties, planting date, and plant populations to maximize crop productivity. In addition, more intensive N management strategies that focus both on improving crop NUE and residue carbon management also contribute to reducing N input over the longer term through increase in soil organic matter and N storage that can increase the indigenous soil N supply capacity. Significant increases in soil organic matter and N storage have resulted from intensification of crop management practices. Intensification has not caused significant increases in the global warming potential of these cropping systems.

Setup

Focus here will be on our 2008 research where rotation sequences were continued but corn was planted in all plots at a population of 30k/A without the application of phosphorus (P) or potassium (K) (no M1* or M2** treatments). A single blanket N application of 50 lbs/A was made to corn prior to planting. Corn was irrigated as in the past and harvested to determine the impact of recorded changes in soil quality on grain yield and nutrient uptake. Herein, we will report on corn yield, NUE, and changes in both soil C and N over the course of the experiment and the residual effect of changes in soil quality on corn yield.

Corn yields bumped

Corn yields illustrated in Figure 1 (upper graph) are those resulting from N supply in response to indigenous soil supply and the N supplied at 50 lbs/A to all corn plots in 2008. Corn population was 30k/A. In the lower graph of Figure 1 are the levels of residual preplant soil nitrate in the upper 12 inches of soil. There was little difference in residual nitrate in the continuous corn (CC) treatments as a function of treatments in previous years. In 2007, there were differential N applications applied to soybean plots and so soil nitrate levels were quite variable. Even so, there was no significant impact of soil nitrate in the corn/soybean (CS) rotation on subsequent grain yield in 2008. Most of the salient impact of previous management history on "residual" 2008 corn yield was the interaction of rotation, population, and fertility management.

Yields of corn after soybeans were 150 percent of continuous corn on the average, apparently the result of elevated soil nitrate (in part) and lack of N immobilization pressure. As we have observed, however, the indigenous soil N supply experienced in CS rotation is the result of a considerable degree of soil C and N loss (Figure 2 and Table 1). The increase in indigenous N supply under CC was evident. Here we have observed significant increases in indigenous N supply under the long-term M2 treatment with soil N sequestration the result of increase in C input to the soil with added N. Surprisingly, we observed a

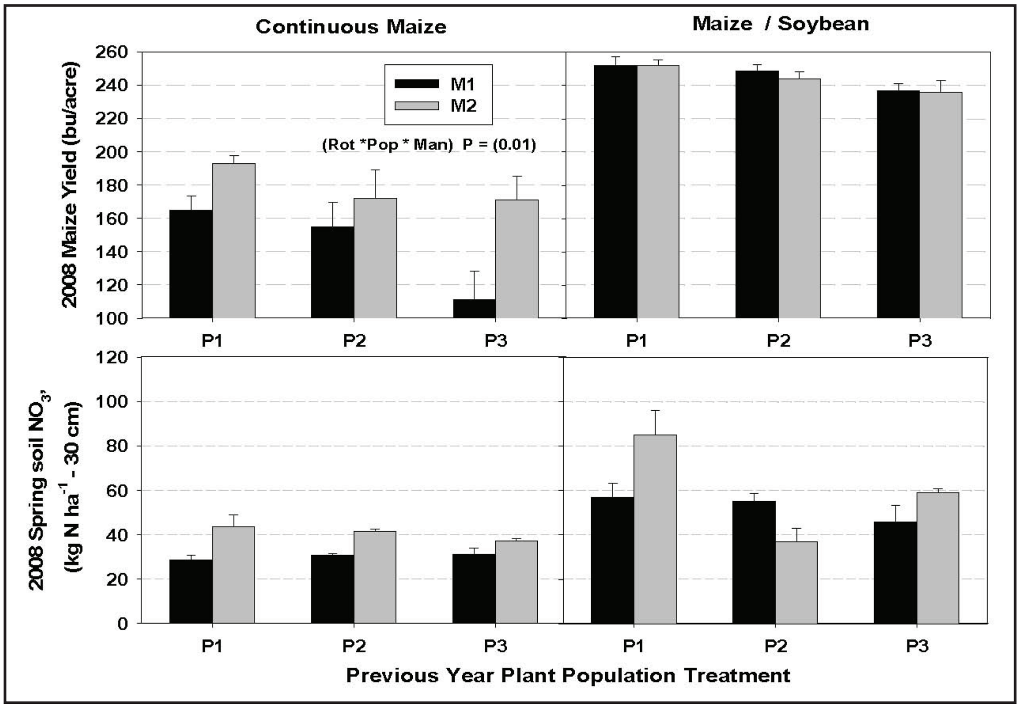

Figure 1. Upper graph: *2008 "residual" corn grain yield as a function of previous year's plant population, previous crop, and long-term fertility management.* ***Lower graph:*** *Spring 2008 soil nitrate N in the upper 30 cm of soil. Plant population density: P1-30, P2-37, and P3-44 1,000 plants/A).*

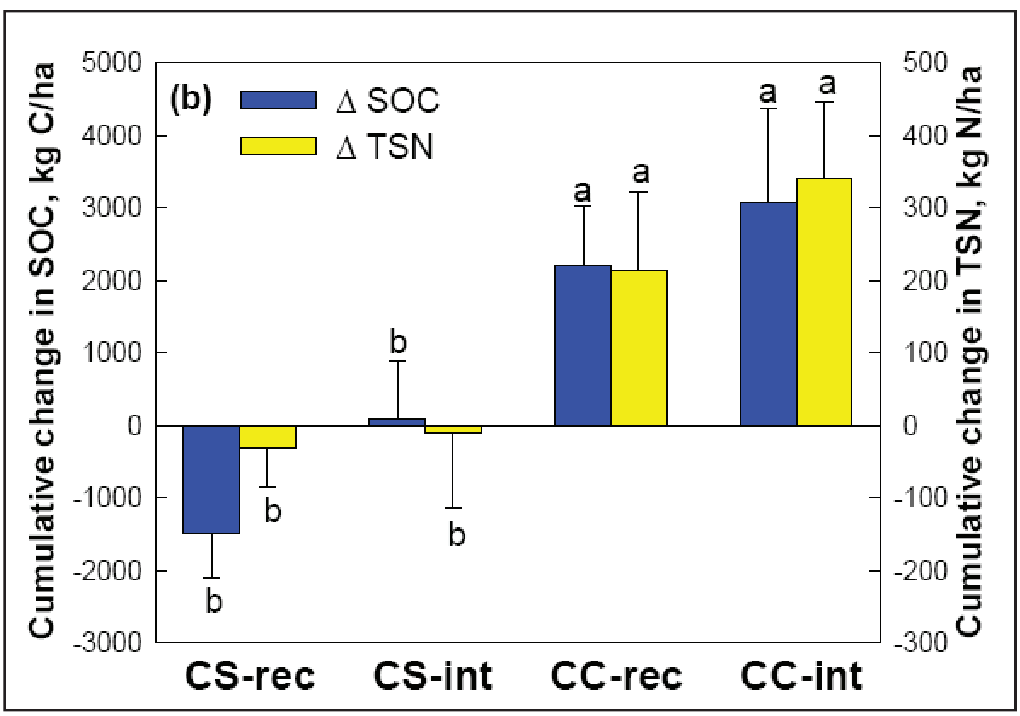

Figure 2. Cumulative change in soil C (SOC) and soil N (TSN) after six years of treatment. CS = corn/soybean rotation; CC = continuous corn; rec = recommended nutrient management @ 30k plants/A; int = intensive nutrient management @ 37 to 44k plants/A.

latent soil N immobilization pressure resulting from long-term input of high C:N residue under the CC-M1 treatment (Figures 1 and 3). The net effect of previous residue C and N input (population in 2007 was P1=30k, P2=37k and P3=44k/A) was a decline in yield of 54 bu/A (from 165 to 111 bu/A.). Even though C inputs were significantly greater in the long run under intensive (M2) management in CC (Figure 3), the sequestration of N and increase in indigenous N supply were evident in 2008 in that yield ranged from 193 bu/A under P1 history to a low of 171 bu/A under P3 history. Therefore, an augmented mineralization potential under M2 history (Figure 3) resulted in a difference of 60+ bu/A (Figure 1).

* M1: 107 to 123 lbs/A of N for corn after soybeans; 161 to 181 lbs/A of N for corn after corn, using UNL N recommendations; no P and K applied (high soil test values). Nitrogen split into two applications (preplant and V6 stages).

**M2: 193 to 266 lbs/A of N for maize after soybeans; 233-324 lbs/A of N for corn after corn; 92 lbs/A of P_2O_5, 93 lbs/A of K_2O, 10 lbs/A of S per crop. Nitrogen split into 4 applications (preplant, V6, V10, and VT stages).

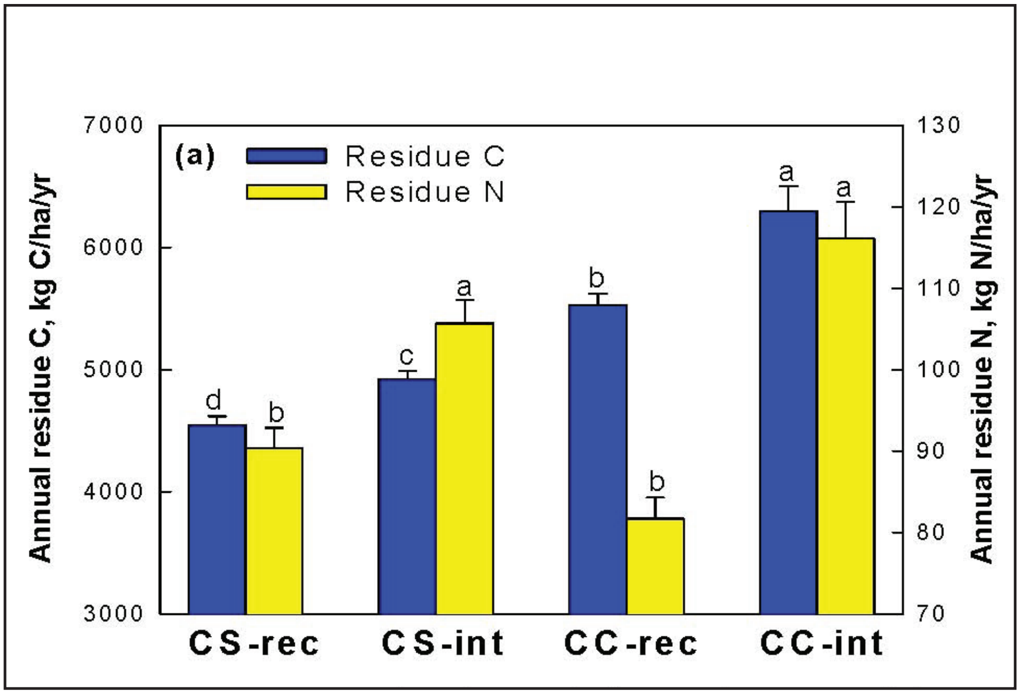

Figure 3. *Average annual C and N input to soil in crop residues. CS = corn/soybean rotation; CC =continuous corn; rec = recommended nutrient management @ 30k plants/A; int = intensive nutrient management @ 37-44k plants/A.*

	CS-Rec	CS-Int	CC-Rec	CC-Int
Annual fertilizer N input, lb N/a	64	156	183	272
Annual N removal with grain, lb N/a	208	216	160	176
Change in total soild N, 0-12", lb N/a	-27	-9	195	309
Nitrogen use efficiency				
lb N in C+S grain/lb N applied	3.27	1.38	0.88	0.65
lb grain N + change in soil N / lb N applied	2.84	1.33	1.95	1.79

Table 1. *System level NUE in CC and CS systems with recommended (-Rec) or intensive (-Int) management (2000-2005).*

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