SASKATCHEWAN

No-till Management Requires Proper Fertilization

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Producers switching to a no-till cropping system must maintain adequate fertility. Otherwise, yields could suffer, and in time soil organic matter may decline. This was evident in a long-term crop rotation study, initiated in 1957, on a fertile Black Chernozemic clay soil at Indian Head, Saskatchewan, in which tillage was changed from conventional to no-till in 1990.

The adoption of no-till management will hasten the negative effects of poor fertilizer management. Not only will yields be reduced, but soil organic matter may decline in unfertilized no-till systems. Growers who are adopting no-till cropping systems need to soil test and apply recommended nutrients. Proper fertilization is imperative to the optimization of production and maintenance of soil organic matter.

Figure 1 shows that from 1953 to 1989, while conventional mechanical tillage was practiced, wheat grown on fallow required very little nitrogen (N) fertilizer (**Figure 1d**). Consequently, there was no difference in yields due to fertilizer (**Figure 1a**). Once we changed to no-tillage in 1990, soil N mineralization in the 20-month fallow period was suppressed, so that fertilizer N requirements for fallow crops was markedly increased (**Figure 1d**), and the yield advantage of the fertilized system over the unfertilized system became quite substantial (**Figure 1a**).

Fertilizer N requirements for wheat grown on stubble have not changed much with the change in tillage (**Figure 1d**). This is because, prior to 1990, these systems received only one preseeding tillage compared to an average of four tillage operations for fallow-wheat. Thus, for the stubble crop systems we see a gradual upward trend in yields of fertilized systems and a slight downward trend in yields of unfertilized systems (**Figures 1b** and **1c**).

These results suggest that by curtailing the frequent soil stirring associated with tillage during the fallow period, we severely reduced the amount of N released from organic matter during this period. The resulting lower soil tests led to the greater requirement for fertilizer. The degrading effect of fallowing, compared to the aggrading conditions of continuous cropping has been reflected in greater N fertilizer requirements for the stubble crop in fallow-wheat-wheat (F-W-W) than for continous wheat (Cont. W) in recent years (1987-1994).

The problem does not end with poorer grain yields, and likely lower protein. It also leads to lower soil organic matter in the long-term (**Figure 2**). Lower grain yields mean less crop residues. Crop residues provide the raw materials for building soil organic matter. The impact of the change to no-tillage was evident when we compared soil organic carbon (SOC) before and after the change to no-till. The systems fertilized with N plus phosphorus (P) were able to maintain SOC, but the unfertilized wheat rotations actually lost SOC. For example, all three unfertilized rotations lost about 1 ton SOC per acre between 1987 and 1996, 6 years after the change to no-till, while SOC in the fertilized systems remained relatively constant.

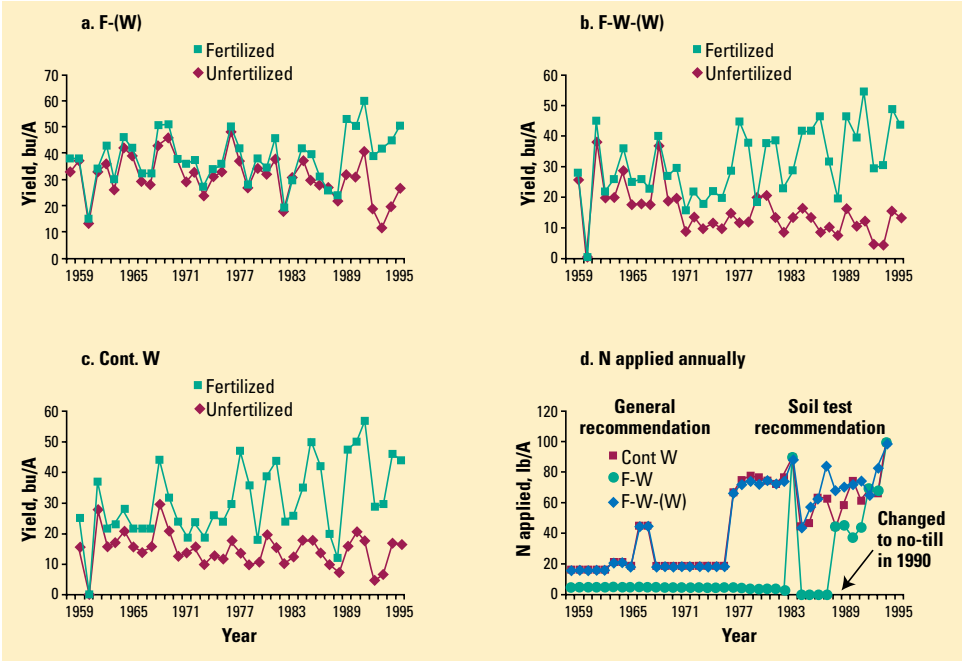

Figure 1. Effect of N and P fertilization and change to no-till management after decades of conventional tillage on spring wheat yields in: a. in fallow-wheat (F-W), b. fallow-wheat-wheat (F-W-W), c. continuous wheat (Cont. W), and on d. annual rates of N applied (rotation phase sampled in parenthesis).

We had expected the introduction of no-tillage (because it increases available soil moisture) to enhance soil SOC, especially in the fertilized systems. It has not done this. It may be that any positive contributions due to increased crop residues are being counterbalanced by greater rates of organic matter decomposition in the more moist soil conditions. BC

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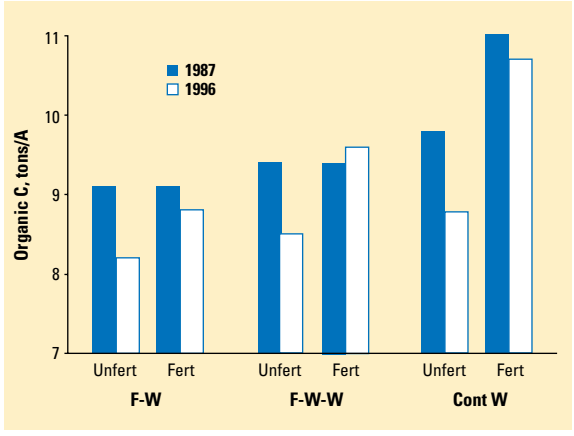

Figure 2. Effect of cropping frequency and fertilizer N+P on SOC in the 0 to 3-inch depth after 30 and 39 years.