

Long-Term Studies Revisited – Fertilization Key to Continued Productivity

By V.A. Bandel and W.K. Griffith

One of the most popular notions concerning nutrient management is that soils in the U.S. have been over-fertilized with phosphorus (P) and potassium (K). Concomitant with that notion is the belief that efficient nutrient management is equivalent to reduced use of commercially produced fertilizers in preference to other sources, e.g. legumes, animal manures and other organics. The intent of this article is not to argue the points of over (or under) fertilization, nor the relative merits of various nutrient sources. Rather, the authors simply present data which show the relationship between sustainability and crop fertilization.

BEGINNING in the early 1970s and continuing through the mid 1980s, a fertilizer trial on corn was conducted at the University of Maryland's Wye Research and Education Center on the Eastern Shore of Maryland. Its design was simple. A complete N-P₂O₅-K₂O fertilizer (160-160-160 lb/A/yr) was compared to a nitrogen (N) only treatment (160-0-0 lb/A/yr). The corn was not irrigated. Ten-year results are shown in **Table 1**. Several points can be made from the data, including the following.

- The N rate was probably close to optimum. However, the P₂O₅ and K₂O rates were higher than those needed to produce best economic yields. Perhaps a 160-80-120 lb/A/yr rate would have been more appropriate.
- Both 1980 and 1983 were drought years. Even under stress conditions, yields were still respectable when P and K were a part of the fertilizer program.

- For the first two years, yield differences were small and might not have been detected under real farm conditions. However, the losses were there. What are the implications of skipping a year or two of P and K fertilization to 'save' money?

In 1984, those plots which had received no P and K for 10 years were fertilized with 68 lb P₂O₅/A and 0, 40, 80, 120 or 160 lb K₂O/A. The reason for holding the P₂O₅ rate constant and varying the K₂O was that K was thought to be the more limiting of the two nutrients. The 68 lb P₂O₅/A rate was according to soil test. Results are shown in **Figure 1**.

Even with N and P, the zero K plot yielded only 33 bu/A compared to 184 bu/A where both P and K were applied for 11 years ... continuing the trend developed in the first 10 years. Yields increased with increasing K₂O rates, yet fell 41 bu/A short of plots receiving

Table 1. Ten-year results of N-P₂O₅-K₂O vs. N fertilization of dryland corn.

N-P ₂ O ₅ -K ₂ O, lb/A/yr	Yield, bu/A for year:									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
160-160-160	151	149	159	153	134	159	122	190	182	125
160-0-0	146	139	116	80	104	37	13	52	23	21
Difference	5	10	43	73	30	122	109	138	159	104
Accumulated yield, bu/A										
160-160-160	151	300	459	612	746	905	1,027	1,217	1,399	1,524
160-0-0	146	285	401	481	585	622	635	687	710	731

Maryland

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LONG-TERM studies in Maryland showed the importance of balanced fertilization for productivity of corn over a period of several years.

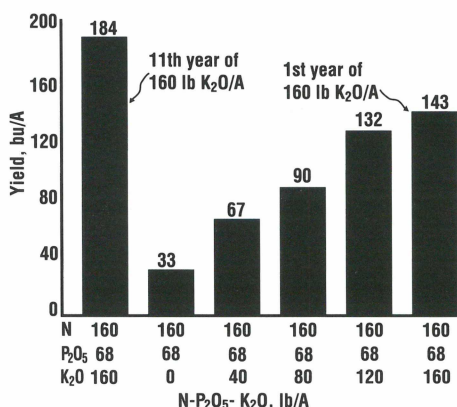


Figure 1. Influence of K₂O fertilization on corn yield (Maryland).

N-P₂O₅-K₂O throughout the course of the study. These data imply that mining soil of its fertility can have extended negative consequences on crop production even after corrective measures have been taken. A “rescue” treatment does not overcome years of neglect.

At the end of the study, soil tests for P and K on the 160-160-160 lb/A/yr plots were high or very high. The zero P₂O₅ and K₂O treatment plots were low in K and medium to low for P. In a qualitative way, these fertility ratings tell the story of adequate fertilization as compared to the practice of mining soils of their fertility . . . and future productivity. This entire study is, in fact, a lesson well learned. That is, proper nutrient

management is critical to long-term productivity . . . sustainability.

Postscript: An Environmental and Economic Exercise

Recognizing that the 160-160-160 lb/A/yr N-P₂O₅-K₂O fertilizer rate was most likely not ‘site specific’ nutrient management, consider the consequences of balanced fertilization as opposed to N only fertilization.

- **Environmental** - As noted in **Table 1**, 1,524 bu of corn were produced in 10 years when a complete N-P-K fertilizer treatment was used. That is close to a bushel of corn (0.95) for every pound of N used. Assuming that a pound of N per bushel of corn is near optimum for this location, then on the plots where P and K were omitted only 768 lb of N would have been used . . . leaving 832 lb of unused N in the soil over the 10 years.
- **Economic** - If the following are assigned as 10-year averages . . . corn \$2.50/bu, N \$0.20 lb, P₂O₅ \$0.25/lb, K₂O \$0.12/lb . . . the economics of the two fertilization schemes can be compared, assuming a farm producing 200 acres of corn per year.

Complete fertilizer . . . Gross income less fertilizer cost: \$579,600.

N only fertilizer . . . Gross income less fertilizer cost: \$301,500. ■