

Inorganic Nutrient Use

By W.M. Stewart and T.L. Roberts

Commercial fertilizers were introduced to North American agriculture in the form of Peruvian guano (seabird droppings) in the 1840s. Production of inorganic superphosphate and mixed fertilizers began in the U.S. soon after the process for acidulating phosphate rock with sulfuric acid was patented in England in 1842. The development of the K industry was accelerated following the outbreak of World War I. Major K deposits were discovered in New Mexico in 1925, and high grade reserves were discovered in Saskatchewan in 1943.

The development of the N fertilizer industry lagged behind P and K until after World War II. The first successful synthetic ammonia (NH_3) plant was built in the U.S. in 1921. Within the next 10 years, several plants were operational. The first NH_3 plants

in Canada came into production during the 1940s.

The use of commercial NPK fertilizers in North America increased rapidly after the middle of the last century, tripling between 1961 and 2000, with much of the increase occurring before 1980 (Figure 1). Higher fertilizer consumption during the 40-year period corresponded to increases in average crop yields. This relationship should not be surprising since it has been estimated that nutrient inputs are responsible for up to 50 percent of total crop yield. While there are some challenges to documenting such estimates, they are generally supported by research. Data from long-term studies representing 157 years of crop production...with significant variability in crop response to nutrient applications because of crop

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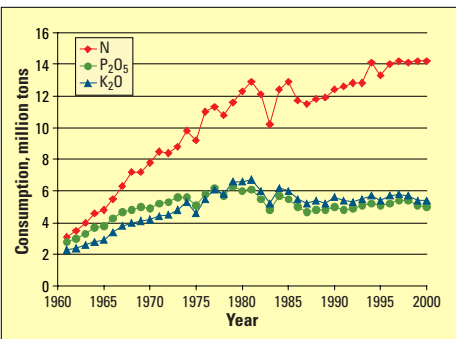


Figure 1. Consumption of N, P_2O_5 , and K_2O in North America (U.S. and Canada) from 1961 to 2000.

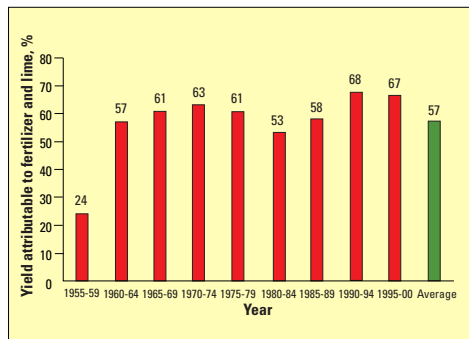


Figure 2. Continuous corn yield from Morrow Plots attributable to N, P, and K fertilizer and lime over 46 years (Reetz, 2001, personal communication).

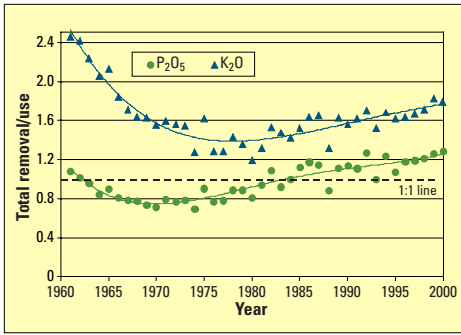


Figure 3. Estimated total nutrient removal relative to inorganic nutrient use in the U.S. from 1961 to 2000.

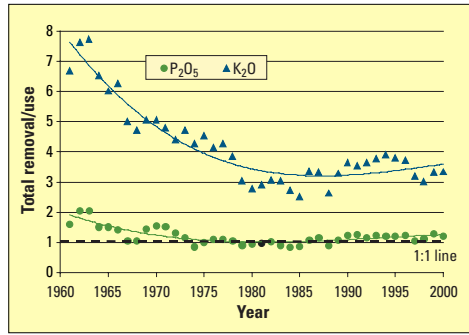


Figure 4. Estimated total nutrient removal relative to inorganic nutrient use in Canada from 1961 to 2000.

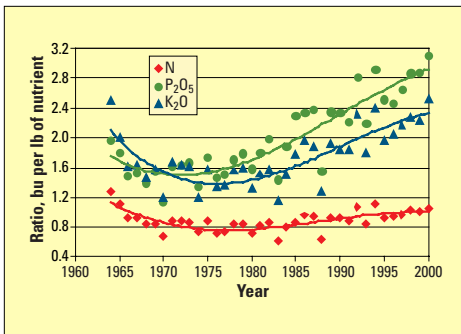


Figure 5. Ratio of corn production to estimated N, P, and K fertilizer use on corn in the U.S.



Commercial fertilizer use in North America is responsible for 30 to 50 percent of crop yield.

species, climate, and other factors...indicate that fertilizer's contribution to total crop yield is in the 30 to 50 percent range. An example of such research is the study established by the University of Illinois in 1876, known as the Morrow Plots. In this study, 57 percent of the yield of continuous corn is attributable to N, P, and K fertilizer and lime (**Figure 2**).

Since the late 1970s, P and K removal/use ratios in the U.S. have been steadily increasing (**Figure 3**). They have also been increasing in Canada, but at a much slower rate (**Figure 4**). In fact, both the U.S. and Canada have been depleting soil P and K for several years if organic nutrient use is not taken into account. However, only a small percentage of cropland in the U.S. actually receives nutrients from manure...17 percent of the corn acres

and 6 percent of the soybean acres.

Even though inorganic fertilizer N use has leveled off and P and K use has dropped in recent years, crop yields continue to climb. As a result, apparent fertilizer use efficiency has increased, as illustrated by corn in the U.S. (**Figure 5**).

While we should continue to strive to improve nutrient use efficiency, we should also keep in mind that at least a part of the apparent improvement in efficiency is the result of mining (depletion) of soil nutrients.

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