What should be the right approach to apply fertilizers for crop production?

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The objective of a fertilizer application program is to optimize agronomic yields without damaging the environment. Fertilizer industry recommends three approaches to fertilizer application; cation saturation ratio (CSR), nutrient build up and maintenance and nutrient sufficiency. Out of these, the latter two are usually followed, primarily because most nutrients, e.g. nitrogen (N), phosphorus (P) sulphur (S), boron (B), chlorine (Cl) and molybdenum (Mo) aren't taken up by crop plants in cationic form, which makes CSR approach redundant for these nutrients.

A basic soil test is fundamental to applying fertilizers. In both nutrient build up and maintenance and nutrient sufficiency approaches, it is admitted that the crop response to a nutrient will be maximum in a soil testing low in that nutrient and the response is unlikely if the soil test is high for that nutrient. OMAFRA specialists and University of Guelph researchers normally recommend nutrient sufficiency approach that advocates application of nutrients at a rate that results in an economic optimum yield. This approach is profit/and crop oriented and may result in gradual build up of soil nutrients. Agronomy Guide for Field Crops, an OMAFRA publication, has nutrient recommendation tables based on accredited soil tests (amount of available nutrients in the soil designated as low, medium, high, very high or excessive). Since agricultural systems are often more complex than what we think of, nutrient response can vary with the management practices (including choice of crop varieties) and weather factors. Under favourable weather conditions, there is a possibility of getting economic response at rates higher than those recommended under nutrient sufficiency approach. Advocates of nutrient build up and maintenance approach therefore recommend to apply fertilizers to bring nutrients in the soil to a level at which the crop yields aren't limited. Thereafter, nutrients can be applied to each crop, equivalent to its removal, to maintain the soil test levels. The approach is often referred to as fertilizing the soil (rather than crop) and may require high initial investment in fertilizer application. However, there is no demonstrated advantage of applying fertilizers to soils that test high in nutrients. Moreover, this approach isn't applicable to nutrients such as N that can be lost from the soil through leaching, denitrification and volatilization.

Some of the soil testing laboratories are recommending the application of nutrients even in soils that are very high/or excessive in some nutrients. This doesn't make economic or environmental sense. Such laboratories may be serving the interests of the fertilizer industry more than those of the agricultural industry. This, I believe, isn't intentional. A Thunder Bay farmer's soil test report from fall 2006 indicates that the soil is very high in P (47 ppm) and excessive in K (288 ppm). The accredited soil lab, in its report, has recommended 53 lb P/acre and 20 lb K/acre for alfalfa (4ton/acre). Whereas, at the Thunder Bay Agricultural Research Station, Thunder Bay, we have observed that there isn't much alfalfa response to P and K in soils testing just about high in P and K. I would therefore recommend the grower(s) not to apply P and K fertilizers in fields testing very high or excess in P and K till the soil test comes down to at least 25 ppm P and 150 ppm K. At these soil tests, P and K are just about high. This could be applied to all soils testing very high/or excess in P and K and to all crops all over the province. However, the

threshold values of P and K could vary with the crops and may be checked from the Agronomy Guide for Field Crops. *The basic approach is not to fertilize soils that are very high/or excess in P and K till the soil tests come down to just about high.* By doing so, farmers can take advantage of both the approaches of fertilizer recommendations (i.e. nutrient build up and maintenance and nutrient sufficiency). This will require soil testing every 2-3 years, and keeping records. Though McCollum (1991) reported that without P additions, 16 to 18 years of corn and soybean production would be needed to deplete soil test P from 100 ppm to agronomic threshold level of 20 ppm (fine sandy loam soil at a depletion rate of ~5 ppm/year).

It may be worth mentioning that apart from environmental risks, excess P can bind micronutrients, such as zinc and manganese, rendering them unavailable to crop plants. Excess K in soil often leads to its luxury consumption and interferes with the uptake of magnesium by crop plants. Excess K in forages can result in metabolic disorders, such as Tetany (deficiency of calcium and some times magnesium), in all ruminants and increased incidence of milk fever and retained placenta in dairy cattle (dry cows). Therefore, why apply P and K to soils very high/or excess in these nutrients and invite problems?

'Fertilizer' in this note refers to both organic (e.g. manure) and inorganic fertilizers!

Reference:

McCollum, R.E. 1991. Buildup and decline in soil phosphorus: 30-year trends on a typic Umprabuult. Agronomy Journal 83:77-85.

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