

Soil Test Levels in North America

By P.E. Fixen

This summary includes results of tests performed on more than 1.8 million soil samples collected in the fall of 1996 and spring of 1997. Soil test data are reported as the percent of samples analyzed that tested medium or below in phosphorus (P) or potassium (K) or had pH values less than or equal to 6.0. These are soil test categories where most agronomists would predict a significant yield response in the year of application to P, K or lime. Most state or provincial supported laboratories that perform a significant amount of agricultural soil testing submitted data for the summary. Several private laboratories also submitted usable data.

Certain weaknesses exist in the summary process. They should be considered in interpreting and using the results of the summary. Weaknesses include:

- The agronomic definition of medium is not consistent, but varies among laboratories due mostly to differences in philosophical approaches.

With the assistance of numerous public and private soil testing laboratories, PPI periodically summarizes soil test levels for phosphorus (P), potassium (K), and pH in North America. This 1997 summary is the seventh completed by PPI, the first dating back to the late 1960s.

- Quantity of samples was low in some states and provinces.
- Some areas of each state or province are likely under or over represented.
- It is likely that the better managers soil test and that their soil tests are higher than the average.

- Home and garden samples frequently could not be separated from agricultural samples. Since these average considerably higher than agricultural samples, they contribute to an upward bias.

- A growing bias is introduced in summaries as the amount of intensive soil

sampling associated with site-specific management increases. A sample representing one acre has the same weight as a sample representing 40 acres.

There are many advantages to high P and K soil test levels. They are important in providing plants with needed nutrients to take advantage of optimum growing conditions and reduce the negative effects of stressful conditions. High soil P and K levels provide protec-

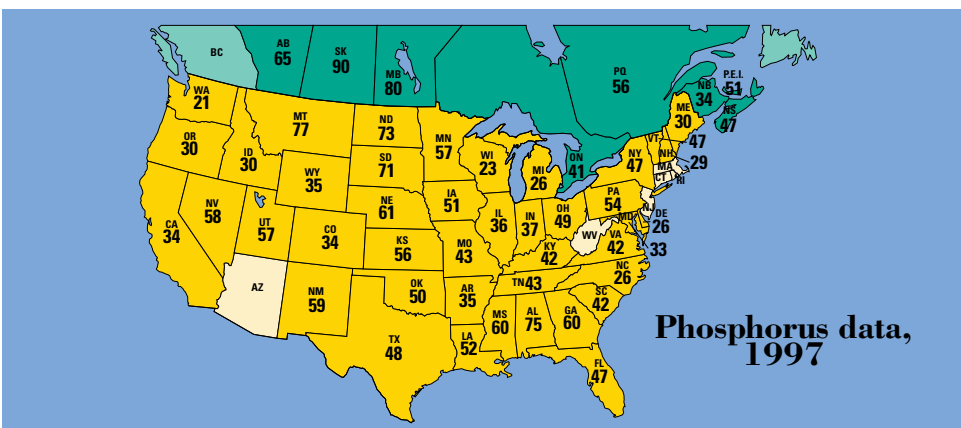


Figure 1. Phosphorus soil test summary – percent testing medium or lower.

tion against deficiencies induced by nutrient stratification in reduced tillage systems plus more options in fertilizer placement, time of application, nutrient application rates, and frequency of soil sampling. High and very high field average soil test levels offer insurance against profit-robbing deficiencies occurring in low testing parts of variable fields. Considering the very high frequency of extreme within-field variability revealed by intensive sampling, this factor alone in many cases justifies building soil test levels to at least the high category.

Because of the factors discussed above, the categories of medium or lower generally represent soils where current P and K use is barely adequate or inadequate...where increasing use above current levels will very likely increase long-term profitability by building soil fertility to a more optimum level. At the same time, it is important to recognize that these nutrients should be protected from loss to avoid environmental degradation. This can be accomplished through proper management. It should not be assumed that because a soil area or field is high in fertility that it represents a threat to water quality or because it is low in fertility that it offers no threat to water quality. Management relative to watershed characteristics makes the difference.

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Of the entire 1.8 million soil samples in this summary, 46 percent and 44 percent tested medium or below in P and K, respectively. As expected, considerable variation existed among states and provinces (Figures 1 and 2). The Northern Great Plains had the highest frequency of medium or below P tests in the 60 to 80 percent range while a few states scattered around the U.S. fell in the 20 percent range. East of the Mississippi River, 16 of 23 reporting states had 50 percent or more of the K tests in medium or lower categories. Western states and provinces generally had fewer soils in the medium or below K categories than those in the East.

The higher K levels of the West reflect the less weathered status of western soils. However, in states such as California where 48 percent of soils test medium or below in K, crop removal over several decades with limited potash addition has significantly reduced soil K levels.

Liming to neutralize soil acidity has long been recognized as one of the foundations of crop production. Increasing soil pH by liming provides a means of improving nitrogen (N) fixation by legumes, improves the availability of other nutrients such as P, and lowers the toxicity of aluminum and manganese.

Soil test summary information for pH is shown in Figure 3. A pH of 6.0 was selected as a breaking point for this summary because

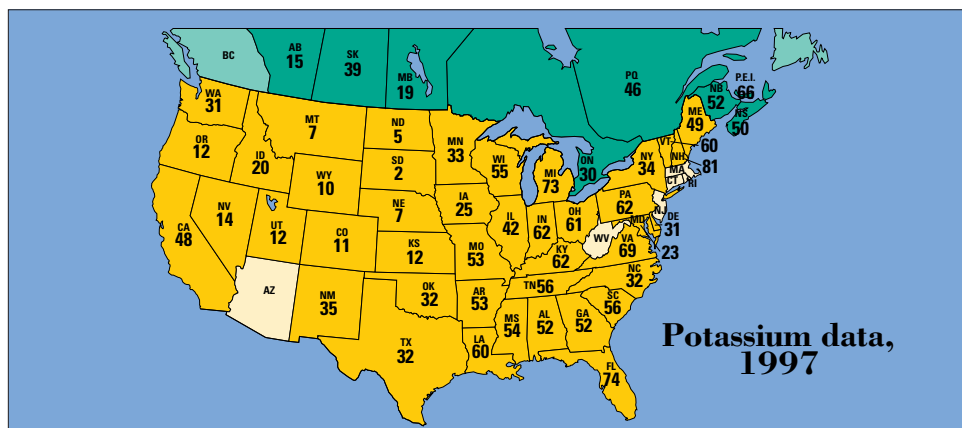


Figure 2. Potassium soil test summary – percent testing medium or lower.

soil pH above 6.0 is desirable for most cropping systems. Historically, soil pH values have tended to be more acid where rainfall is higher and where large amounts of vegetation have helped to acidify the soil. Those conditions have been associated with areas east of the Mississippi River in the U.S. and in the eastern Canadian provinces. However, continued research has revealed that soil acidity problems are not limited to those areas. The highest frequency of soil acidification continues to be found in the southeast where, in some states, over 60 percent of the soils test below pH 6.0.

Conclusions

The common perception that soil test P and K levels are seldom yield limiting in North America is wrong. As indicated earlier, approximately 45 percent of soil samples are currently testing medium or below in P or K. Furthermore, historical trend lines suggest that in many key agricultural states, this percentage is **not** currently decreasing and may even be on the increase. For example, the values for percent medium or below in P or K reached low points in the 1989 summary for the Illinois-Indiana-Ohio region and appear to be on the rise in the 1993 and 1997 summaries. Levels are now approaching the values reported in the first summary for this region in 1975.

In other states and regions, often where animal manure production relative to available land for application is high, percent medium or below in P has been steadily declining throughout the entire summary period. State nutrient budgets that account for nutrients removed in crops and animals as well as the nutrients applied as fertilizer and potentially applied as manure appear to help explain the differences among states in general soil fertility trends.

Nutrient management should occur on a site-specific basis where the needs of individual fields, and in many cases areas within fields, are recognized. Therefore, a general soil test summary like this one has little value in on-farm nutrient management. Its value lies in calling attention to broad nutrient needs, in motivating educational and action programs, and in reminding individual farmers of the importance of a soil testing program to monitor soil nutrient status. [BC](#)

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More detailed information is included in Technical Bulletin 1998-3, available for purchase from PPI...fax (770) 448-0439.

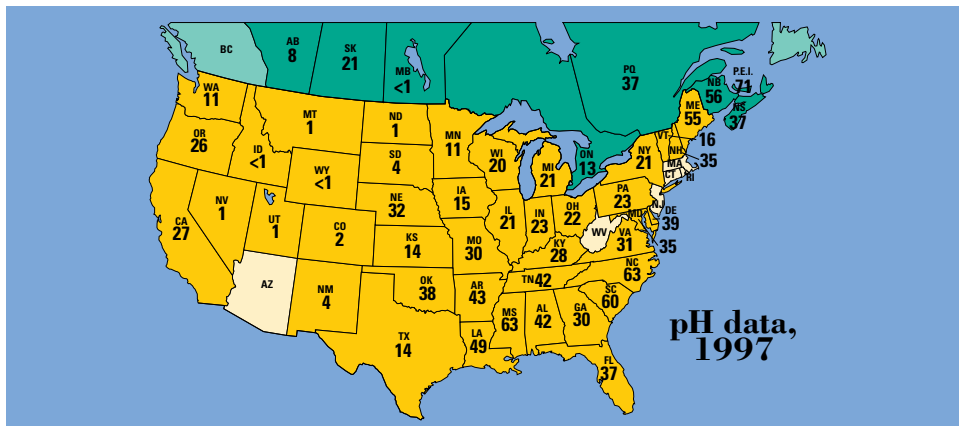


Figure 3. Soil test summary for pH – percent testing 6.0 or less.