SUMMARY UPDATE

Soil Test Levels in North America

By P.E. Fixen

The 2001 summary includes results of tests performed by 34 public and 31 private laboratories on approximately 2.5 million soil samples collected in the fall of 2000 and spring of 2001. Sample density was 166 acres per sample, but varied from a high of 22 for Georgia, New Hampshire and North Carolina to a low of nearly 3,000 for Wyoming. Soil test data are reported in two forms.

- Percent of samples analyzed that tested medium or below in P or 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.
- Cumulative relative frequency across nine soil test ranges. This is the first time multiple ranges were requested from laboratories. As such, not all were able to provide data following this more intensive protocol.

> With the cooperation 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 2001 summary is the eighth completed by the Institute, with the first summary dating back to the late 1960s.

Great appreciation is extended to all the laboratories cooperating in the summary. They were asked to do considerably more work than in the past, resulting in what is likely the most comprehensive evaluation of the status of soil fertility in North America ever conducted.

Several weaknesses exist in the summary process:

- Quantity of samples was low in several states and provinces.
- It is possible that some samples originated out of the state or province

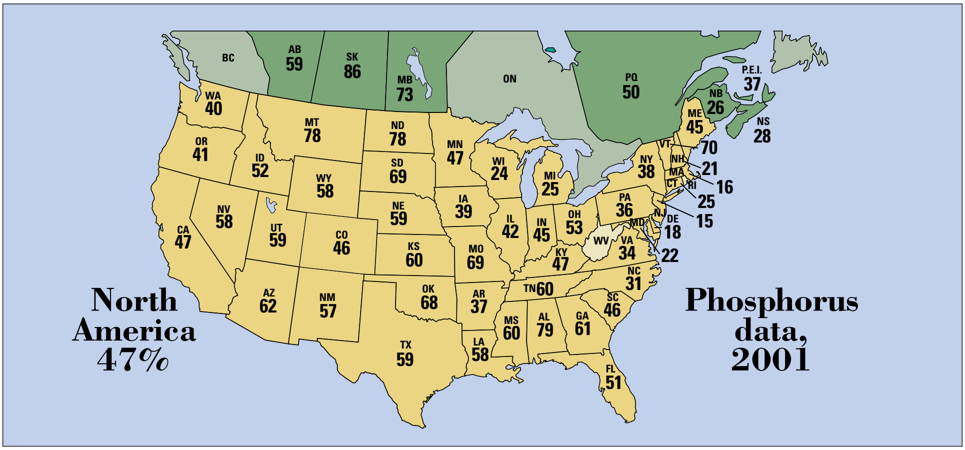

Figure 1. Percent of soils testing medium or lower in P.

indicated.

- 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 sometimes could not be separated from agricultural samples. Since these average considerably higher in fertility than agricultural samples, they contribute to an upward bias.
- Although an attempt was made to define agronomic equivalency for each of the nine categories among the various soil test procedures, it is likely that error was introduced in this process.
- In many states and provinces, soil test K levels interpreted as medium will vary markedly depending on soil texture, soil mineralogy, physiographic region, and the crops to be grown.

These weaknesses need to be considered in interpreting and using the results of the summary.

There are many benefits of 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. They provide protection against deficiencies induced by nutrient stratification in reduced tillage systems, plus offer 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 below 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 optimum levels. 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.

Of the entire 2.5 million soil samples in this summary, 47 percent tested medium or below in P and 43 percent tested medium or below in K. As expected, considerable variation existed among states and provinces (**Figures 1** and **2**). The northern Great

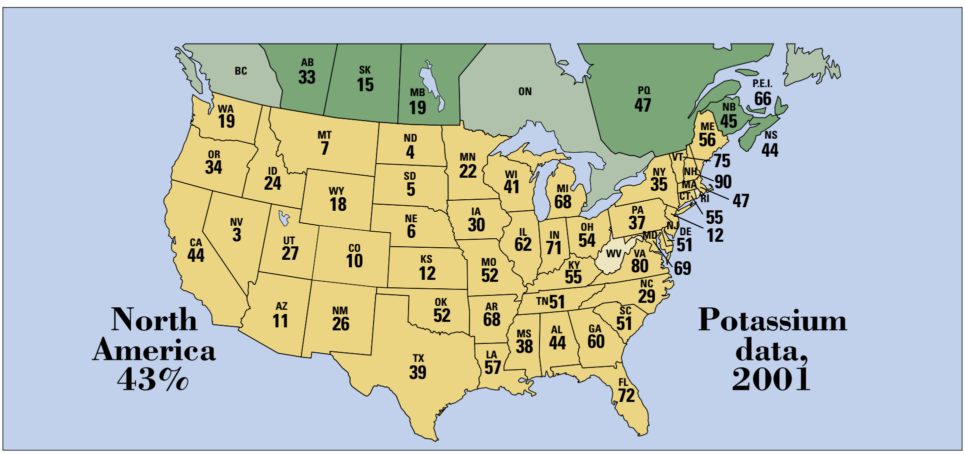

Figure 2. Percent of soils testing medium or lower in K.

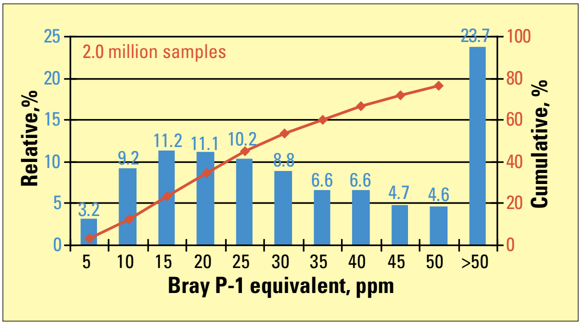

Figure 3. Soil test P frequency distribution for North America in 2001.

Plains had the highest frequency of medium or below P tests with values in the 60 to 90 percent range, while a few states in the Northeast dropped below 20 percent. 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 44 percent of soils test medium or below in K, crop removal over several decades with limited nutrient addition has significantly reduced soil K levels.

Relative frequencies and cumulative relative frequencies for soil test P in North America are shown in **Figure 3**. Soil test P shows a skewed frequency distribution with a broad peak running from 5 to 30 parts per million (ppm) Bray P-1 equivalent and accounting for over 50 percent of the samples. Another 24 percent of the samples test greater than 50 ppm.

Relative frequencies and cumulative relative frequencies for soil test K in North America are shown in **Figure 4**. Over 50 percent of the soils in North America test below 160 ppm K, and over a third test between 120 and 200 ppm. This distribution is compelling evidence of the need for proper and regular soil testing to carefully monitor soil K status. Many soils test near or below what most calibration research indicates is a critical level for crop response.

Percent of soil samples testing 6.0 or below in pH for each state and province is shown in **Figure 5**. A pH of 6.0 was selected as a breaking point because 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. But, 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

Approximately 45 percent of soil samples are currently testing medium or below in P or K. Historical trends apparent from the eight soil test summaries now completed suggest that in many key agricultural states this percentage is increasing. For example, P soil fertility appears to be decreasing in the heart of the Corn Belt, and K levels appear to be in decline in the eastern states of the Corn Belt. These data are supported by nutrient budget estimates for the Corn Belt that show crop removal exceeding P and K application.

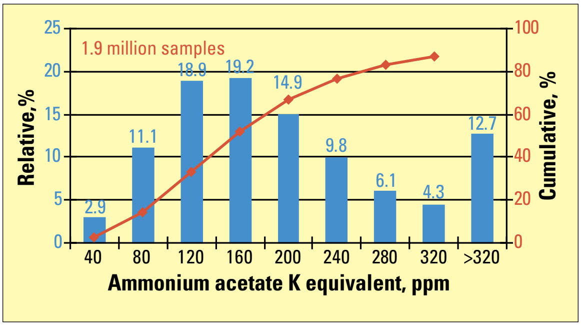

Figure 4. Soil test K frequency distribution for North America in 2001.

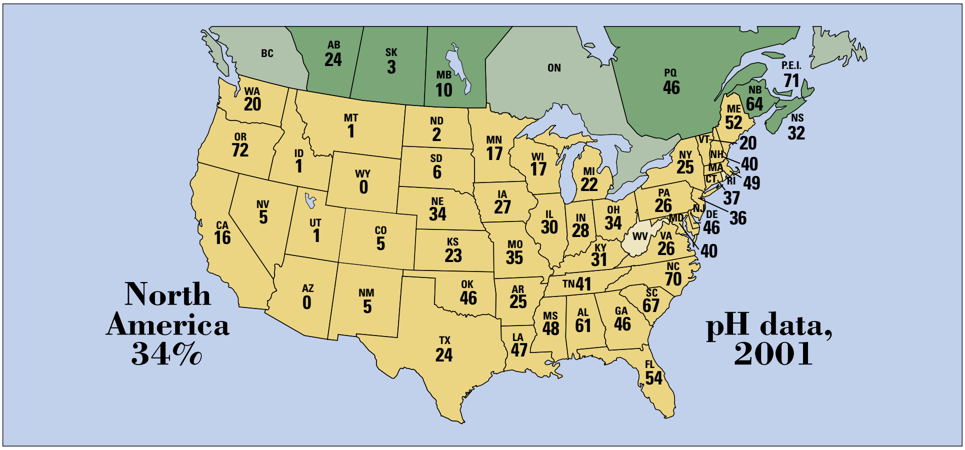

Figure 5. Percent of soils testing 6.0 pH or less.

The impact of manure production on regional soil test levels is apparent in this summary as it was in the 1997 summary. Generally, in regions where manure production is high relative to crop nutrient removal, a lower percentage of soils currently test medium or below in P, and percentages are trending even lower.

Results indicate the importance of regular soil testing because a large number of samples test in or near critical soil test ranges where nutrient recommendations vary greatly. These data also amplify the need for representative soil sampling.

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 no 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 farmers and their advisers of the importance of a soil testing program to monitor soil nutrient status.

More detailed information is included in Technical Bulletin 2001-1 and accompanying CD, available for purchase from PPI. Check the website at www.ppi-ppic.org or contact the Circulation Department, phone (770) 825-8082, fax (770) 448-0439. BC

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Correction to Data in Better Crops No. 4, 2001

A calculation error occurred in **Table 3** of the article "Spring Wheat Cultivar Response to Potassium Chloride Fertilization", which appeared on page 23 in *Better Crops with Plant Food*, No. 4, 2001. In the column listing mean yield response to chloride fertilizer for three years on fine sandy loam soil, the value for yield mean response should be 2.7 bu/A for the cultivar CDC Teal. The value is incorrectly shown as 8.0 bu/A. BC