



Comparison of Land Grant University Soil Test Recommendations for Nitrogen, Phosphorus and Potassium

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Abstract

Variations in fertilizer recommendations across state boundaries for a given crop based on soil testing have the potential to affect cost share programs for agricultural producers. Land Grant University (LGU) nutrient management personnel, in cooperation with USDA-NRCS regional personnel, compared soil test recommendations for adjacent states in the Western (Washington, Idaho, Oregon), Central (Kansas, Nebraska), and Eastern (North Carolina, Virginia, Tennessee) U.S. A common spreadsheet was used to compare N, P and K recommendations for expected yield goals of three major crops across soil test ranges from very low to very high. Recommendations for selected crops also were compared for scenario soil samples representative of shared watersheds. In general, fertilizer recommendations in adjoining states within a region were very similar across the range of soil test levels for the major crops and cropping systems evaluated. Variations in fertilizer N, P and K recommendations based on soil test and/or yield goal, soil type, organic matter content, or nutrient index (e.g. P-Index) typically ranged from 0 to 14%. Selected cases of more substantial percentage variation (33 - 150%) in N recommendations were observed, but typically were associated with the very high soil test range where lesser total amounts of fertilizer N are recommended. Variations in P fertilizer recommendations among states within a region generally were less than 10%. More significant variations in fertilizer K recommendations suggested that K is less aggressively managed than N or P, likely due to historical economics and limited environmental concern. Management practices such as method of application (band vs. broadcast) can significantly affect recommendations and apparent consistency between/among states. Results indicated that support for enhanced collaboration among LGU nutrient management programs could lead to significant and meaningful improvement in nutrient management recommendations available to agricultural producers, land managers, and state and federal water resource management agencies.

Introduction

It is important to recognize there are many aspects to soil testing that cause differences in nutrient recommendations. Soil testing and the resulting nutrient application recommendations have progressed over many decades. Soil test extractions, methodologies, and calibration of nutrient recommendations to yields were developed primarily at state levels. Different soil test philosophies also developed. For instance, many labs use the Mehlich-3 extractant, but the nutrient recommendations will be different due to the "philosophy" that the soil test lab uses: one lab may use a sufficiency philosophy, while another will use a buildup and maintenance strategy. These differences in philosophy will change the fertilizer recommendations. In addition to these differences, resources for continued calibration of soil tests and the development of new soil test procedures have been scarce for at least twenty years. Some recommendations may be outdated due to the lack of resources, both human and monetary, in the realm of soil testing.

The Conservation Security Program (CSP) is a new program that rewards farmers for good conservation practices, including nutrient management, and focuses on watersheds. However, some watersheds cross state boundaries and personnel of USDA-NRCS have discovered that nutrient recommendations may vary between states. As a consequence, land-grant faculty representing the three NRCS regions compared nutrient management recommendations in selected adjoining states.

Approach

LGU nutrient management personnel compared soil test recommendations for adjacent states in the Western U.S. (Washington, Idaho, Oregon), Central U.S. (Kansas, Nebraska), and Eastern U.S. (North Carolina, Virginia, Tennessee).

A common spreadsheet was used to compare N, P and K recommendations for 3 major crops across soil test ranges of very low, low, moderate, high and very high, and yield goals, as appropriate.

Recommendations for selected crops were developed and compared for "scenario" soil samples representative of potential situations in shared watersheds.

Table 1. Comparison of Land Grant University soil test recommendations for corn, potatoes and wheat in Idaho, Oregon and Washington.

Table 2. Comparison of Land Grant University soil test recommendations for corn, soybean and wheat in North Carolina, Virginia and Tennessee.

Table 3. Comparison of Land Grant University soil test recommendations for corn, soybean and wheat in Kansas and Nebraska.

Phosphorus

- Recommendations for fertilizer P were remarkably consistent among states within a region for the major crops evaluated; variations generally were less than 10%.
- Significant exceptions were observed for corn, Very High potatoes and Very Low wheat in the Western region, and soybean in the Eastern region.
- Management practices, such as method of application (band vs. broadcast) can significantly affect recommendations and apparent consistency. For example, the Washington recommendation for wheat is based on subsurface banding and is doubted if fertilizer is applied broadcast, while Idaho makes no distinction based on method of application.
- Scenario samples indicate that state-to-state variation may occur due to lack of sufficient yield based sensitivity in recommendations for some states. In some cases, insufficient field validation data may be present to support more prescriptive rate recommendations.
- The potential value of common guides, where appropriate, is evidenced by consistency in rate recommendations for potatoes in Oregon and Washington.

Potassium

- Potassium recommendations were reasonably consistent for the major crops evaluated with the exception of High and Very High potatoes in the West where Idaho was markedly lower than Oregon or Washington (which use the same fertilizer guide), and wheat in the East.
- Recommendations for wheat were notably lower in Tennessee for all soil test ranges and for soybean in the Low range compared to North Carolina or Virginia.
- Significant variations in fertilizer K recommendations may demonstrate the tendency for broader classification that is based on soil characteristics (texture, mineralogy) and original research in the predominant production areas for a crop within a state. For example, Oregon's wheat guide indicates that soil potassium levels are naturally high or very high and soil fertilizer potassium is recommended. In addition, due to its greater leaching potential K unlike P can be more transient in coarse textured soils.
- In general, potassium appears to be less aggressively managed than N or P, as might be expected based on historical economics and limited environmental concern.

Nitrogen

- In general, there was a high degree of consistency among states within a region for N fertilizer recommendations based on soil test nutrient level and/or a combination of other parameters including yield goal, soil mapping unit, organic matter content, etc.
- Variations in N recommendations generally ranged from 0 to 14% for samples in the low to medium soil test categories.
- In many cases, fertilizer recommendation ranges between adjacent states overlapped or were inclusive of ranges for adjacent states; thus, differences in observed recommendations would be due to site specific interpretations.
- Selected cases of more substantial percentage variation (33 - 150%) in N recommendations were observed, but typically were associated with the Very High soil test range where lesser total amounts of fertilizer N are recommended. For example, N recommendations for 200 bu/acre irrigated corn in soils testing Very High were 20 and 50 lbs N/acre for Idaho and Oregon, respectively.
- Many northcentral and southeastern U.S. states do not utilize a soil test for N; thus, credits for measured N used by some states could result in differences in fertilizer recommendations. In addition, some states provide N credits based on measured or classified soil organic matter content while others do not.
- Differences in fertilizer N recommendations for some scenarios were related to differences in predicted crop yield potential, not differences in soil test results.
- Some states have developed fairly sophisticated predictive tools based on state-specific research (e.g. North Carolina recommendations are based on yield potential, soil mapping unit and soil management group) that result in more prescriptive recommendations.

Summary

- Overall, soil test recommendations for N, P and K in adjoining states within a region (West, Central, East) were very similar across the range of soil test levels from Very Low to Very High for the major crops and cropping systems evaluated.
- Variations in fertilizer N, P and K recommendations based on soil test and/or yield goal, soil type, organic matter content, or nutrient index (e.g. P-Index) typically ranged from 0 to 14%. This application range is often within the range of fertilizer spreader technology and in the area of nutrient application does not represent true differences.
- Differences in soil test methods and philosophies do exist among states within a region; however, recommendations generally are not substantially different where sufficient field calibration has been possible.
- Management practices, such as method of application (band vs. broadcast) can significantly affect recommendations and apparent consistency between/among states.
- Differences among states in other nutrient management tools such as the P-Index and Code 590 standards can contribute to differences in recommended fertilizer application rates across state boundaries and within a shared watershed.
- Establishment and publication of standard soil testing methods and procedures for states, multi-state groups, and where possible, regions could promote greater consistency in soil testing procedures and fertilizer recommendations among private and public laboratories. For example, the Western Region has developed a manual (Gavlak, et al., 2003) that summarizes extraction and analytical methods recommended for use in the Western U.S.
- Development and publication of multi-state guides for major crops could provide significant opportunity to identify and minimize the degree of variation among states in fertilizer recommendations. Some states and/or regional groups already have worked to coordinate development of recommendations for some major crops, e.g., Oregon and Washington use the same fertilizer guide for potatoes.
- Results strongly suggest that support for enhanced collaboration among LGU nutrient management personnel could lead to significant and meaningful improvement in nutrient management recommendations available to agricultural producers, land managers and state and federal land and water resource management agencies.

Recommendations:

- Promote greater coordination among state LGU nutrient management programs and with NRCS personnel to better understand soil test recommendations for the primary nutrients in states with significant shared production zones and watersheds.
- In concert with state NRCS personnel, identify critical areas where special projects (joint LGU/NRCS) may be warranted to address substantive variations in fertilizer recommendations based on LGU recommendations and/or implementation of state specific Code 590 or other impacting standards.
- Support implementation of a national initiative focused on collaborative multi-state/regional development of crop fertility recommendations that:
 - Evaluates existing soil test methods and recommendation procedures used for major crops and cropping systems.
 - Identifies and addresses critical areas of research need related to method development, correlation and calibration.
 - Facilitates the development of more similar nutrient guidelines and recommendations (when appropriate) between/among adjacent states for crops and cropping systems in similar production zones.