MIDWEST

Maintenance + Buildup Nutrient Management for Site-Specific Systems

By H.F. Reetz

In applying the maintenance + buildup system to site-specific management, it is important to understand system components and how they may be affected by a more intensive management plan.

Maintenance

The maintenance component involves applying nutrients to the soil in proportion to the amounts removed in the harvested crop. Standard tables can be used. More accurate estimates result from the analysis of grain or forage removed from the field. Variations in genetic makeup, weather conditions, and management factors often significantly influence the actual nutrient removal by the crop. Adjustments are made to account for crop residues and manure added back to the soil.

The maintenance application can be made annually, but more commonly an estimate is made of the total nutrient removal for all crops in the rotation and applications made accordingly, often once in the rotation cycle. If soil tests are being maintained at levels supportive of optimum yields for all crops, adjustments for any discrepancies between expected yields and actual yields can be made in formulating application rates for the next crop cycle.

Determining yield goals is a critical component of maintenance. It is generally recommended that yield goals be based upon the average of the last 3 to 5 crop years, with some consideration given to known increments of technology and allowance for obvious abnormal growing seasons. When setting yield goals for individual areas of a field, these considerations become even more important because the year-to-year variations due to weather often have greater influence on measured yields for the smaller areas.

One of the more popular nutrient management concepts, especially in the Midwest U.S., is the **Maintenance + Buildup System**. This approach lends itself well to site-specific nutrient management, because it allows for separate consideration of the soil test level and the crop removal components of nutrient management.

Buildup

Where soil test levels are less than optimum for producing maximum economic yields, buildup applications are made in addition to the maintenance application. Rates of buildup nutrient application needed depend upon soil types and the time interval over which the producer would like to extend the buildup period. Soil characteristics affect the amount of nutrients needed to build soil test levels — and the level to which they can be built. The farmer's economic situation, the value of crops to be grown, and the number of years the operator plans to

farm the field are among the considerations in determining the time interval over which buildup applications are to be made.

For a silt loam soil in the Midwest, standard buildup estimates are approximately 4 lb/A of K_2O to build soil test K level by 1 lb/A, and 9 lb/A P_2O_5 to build the soil test P level by 1 lb/A. The actual responses for individual soils may be considerably different than these averages. Soil variability, the initial soil test level, the target level, and many other factors affect these estimates. Nutrient and yield records on a given field and the farmer's past experience are important considerations in estimating actual buildup requirements. In some cases, soil characteristics will dictate that the buildup approach is not appropriate due to leaching potential, nutrient fixation by the soil into unavailable forms, and other factors.

Soil Test Goal

A soil test goal is established and nutrients are added to attempt to build soil test levels to reach that goal. Most buildup goals are established in reference to long-term research that has determined the appropriate soil test levels above which the nutrient should not be limiting for the crop to be grown. These levels are different for different crops and soils. Generally, they have been established slightly above the expected crop response range, so that if the level fluctuates during the crop rotation cycle, yields will not be adversely affected. Re-testing at regular intervals, usually every 3 to 4 years, helps determine progress toward the goal.

Some universities, such as the University of Wisconsin, have elected to move the recommended buildup level down to the range where the soil test level plus the annual maintenance application will be sufficient to meet the needs of the crop. This approach results in a lower buildup investment, but makes it much more critical to have accurate yield estimates upon which to make recommendations for maintenance applications.

Site-Specific Systems

As nutrient management switches from a focus on field-average recommendations toward managing different areas of a field differently, there may be less flexibility in the recommendations made for a given field. It is important to keep in perspective that soil tests do not give an actual measurement of nutrient levels in the soil, but rather provide an index of the nutrient supplying capability of the soil. This index is valid only in conjunction with its calibration data that provide the relationship between the index number and the expected yield response, usually based on nutrient-response studies conducted in field plots over a period of years. These relationships were developed with the intention that they would be used for field-average nutrient management decisions. It may take several years' point-sampling and yield monitor data to determine whether these calibration data and soil test indices are appropriate for site-specific management of areas of 1 to 3 acres in size. But for now, they are the best estimates available.

With field-average management, assuming nutrient applications are made according to a sound soil testing program, there is a tendency to increase the variability of soil test levels within the field. Areas of the field producing yields above average will tend to become depleted in nutrients because removal will exceed the average maintenance application rates. Areas producing below-average yields will tend to build soil test levels because nutrient removal will be less than the average maintenance rates. While this may not be a major concern in the short-term, long-term effects can result in

reduced yields in the most productive areas of the field and unnecessary expenses and environmental risks from applying excess nutrients to the less productive areas of the field.

With site-specific management, maintenance nutrient applications can be targeted to the variable productivity of the field, so that some of the variability can be removed, but all of it can be managed to be sure nutrients are applied where they will do the most good. This will avoid depletion of nutrients in the most productive parts of the field and eliminate unnecessary buildup of nutrients in the less productive parts of the field.

Sampling for Site-Specific Management

Site-specific management allows maintenance and buildup recommendations to be made for a smaller geographic area of the field, taking into consideration the variability in soil test levels, soil types, topography and variability in yield. Under such a system, buildup applications are based upon soil tests, preferably taken with geographically-referenced sampling points using global positioning systems (GPS). Maintenance applications are determined from yield maps generated from on-the-go yield monitors, with yield data also geographically referenced by GPS systems.

A field-by-field data base of variability in soil test levels, nutrient application over time, and yield for all crops in the rotation can be developed and catalogued in a geographic information system (GIS). The GIS can then be used to aid in the interpretation of the relationships of various nutrient factors to yield and profitability. Areas as small as 1 to 3 acres may be managed separately as if they were individual fields. Individual soil samples collected for site-specific management should be made up of a composite of 4 to 8 cores collected from within a 10 ft. radius of the sample point.

Each sample point should be geographically-referenced and kept separate for analysis and interpretation. Whether the sample points are selected on a uniform grid basis or located by soil type, topography or some other means should be determined by the farmer and his advisers based upon their knowledge of the field. The ability to document soil tests, field observations, and yield with precise geographic coordinates to within a few feet allows for accurate positioning of both analytical data and yield data. Thus, recommendations can be made to adjust for these measurements in making future nutrient applications.

Maps Won't Match

The expectation that crop yield maps will match variability in soil test maps will most likely lead to disappointment. If the field has been managed according to a good soil testing program, soil fertility has likely been eliminated as a major limiting factor in determining yield. Most yield variability is likely to be more directly caused by other factors such as compaction, water management, tillage, pest problems, etc. Furthermore, as discussed above, field average nutrient applications lead to variability that is inversely correlated to yield level.

This does not mean that site-specific sampling and variable-rate nutrient application are not applicable or important. In fact, site-specific nutrient management will, over time, bring the soil nutrient levels more in line with the general productive capacity of the different parts of the field, so that yield maps and nutrient maps may eventually be more directly correlated. BC

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