NEWS & VIEWS

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Phosphorus and Potassium Balance — Challenges and Opportunities in the Southeast Region

OPTIMUM, BALANCED PLANT NUTRITION is one of the keys to achieving profitable crop yields each year. It also is fundamental to sustained production into future years. Balanced plant nutrition affects crop quality, crop resistance/tolerance to certain diseases, the performance of animals which consume the grain and forages, and environmental quality.

Soil and plant tissue testing are time and research-proven tools everyone should use to best manage plant food nutrients. Skilled agronomists rely heavily on these tools, but also consider plant food removed in harvested crops in balancing their nutrient management programs. If plant food removal exceeds nutrient inputs (fertilizer, manure, rainfall, irrigation), the soil fertility resource will degrade and soil productivity will decline. Conversely, if nutrient inputs exceed removal, then soil fertility will increase.

There have been many agricultural changes in the Southeast in recent decades which can affect nutrient balances in individual states, counties, farms, fields, and subfield areas. Some of these changes include: declines in tobacco and peanut acreages, increases in cotton acreage, increases in irrigated acreage, and an increase in confined animal feeding operations. For the Southeast Region as a whole, fertilizer phosphorus (P) and potassium (K) consumption declined from 1985 to 1987, but increased gradually afterward. Consumption of P has been declining since about 1998 and K has been declining since 1996 (**Figures 1 and 2**). These declines in P and K usage in the Southeast are caused in part by a depressed farm economy, but have also been impacted by an abundance of poultry and swine feeding operations in the region. For example, some southeastern states lead the nation in the number of poultry broilers (**Figure 3**), and North Carolina is second only to Iowa in the number of hogs produced (**Figure 4**).

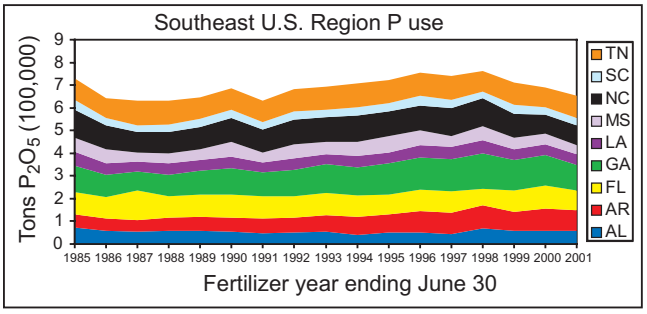

Figure 1. Fertilizer P consumption by states within the Southeast Region.

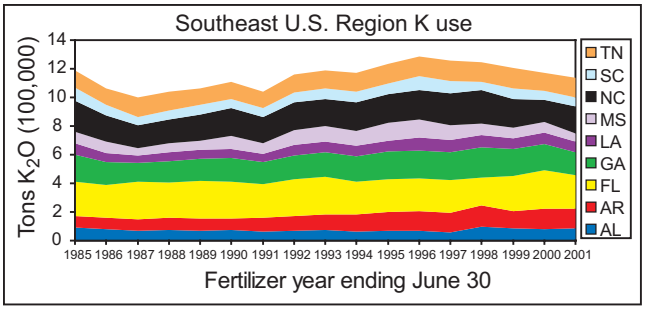

Figure 2. Fertilizer K consumption by states within the Southeast Region.

Animal feeding operations are often not uniformly distributed among counties, as illustrated for hog numbers in North Carolina (**Figure 5**). The resulting distribution of the manure resource can cause an imbalance with crop, forage, and forest nutrient needs. The differences in manure P resources among counties and the ability of the manure alone to meet crop P needs is illustrated in **Figure 6** for North Carolina in 1993.

One of the biggest obstacles faced by animal feeding operations is finding a way to land-apply the manure to fields with an agronomic need. The distance to significant

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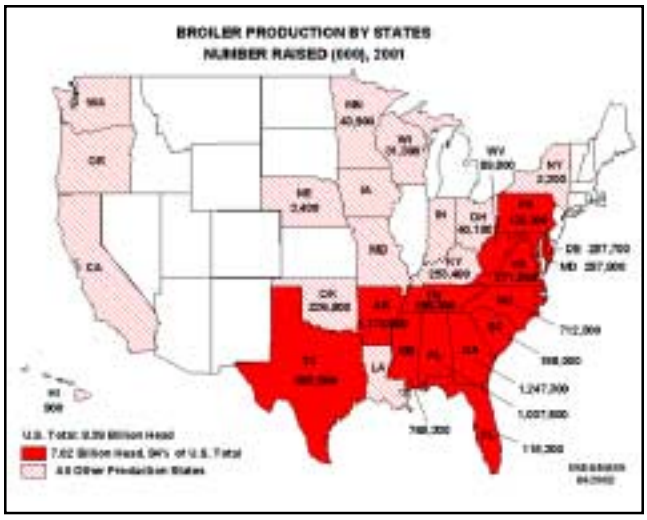

Figure 3. Broiler production by states in 2001.

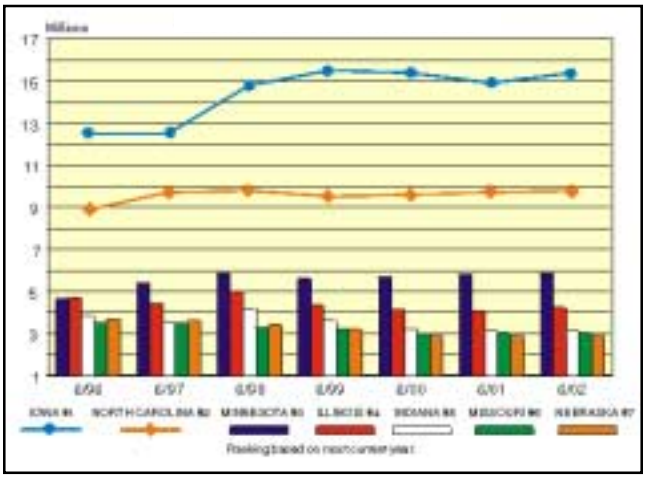

Figure 4. Hog inventory in leading states. (Source: North Carolina Department of Agriculture & Consumer Services-Agricultural Statistics Division.)

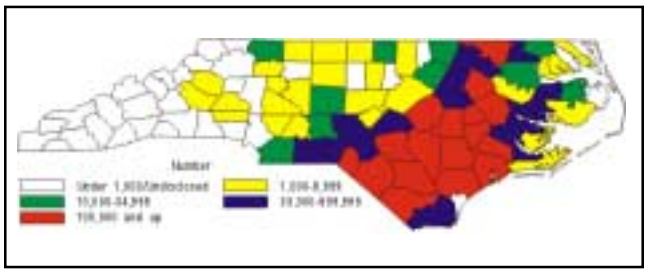

Figure 5. Hog inventory (2001) in North Carolina counties. (Source: North Carolina Department of Agriculture & Consumer Services-Agricultural Statistics Division.)

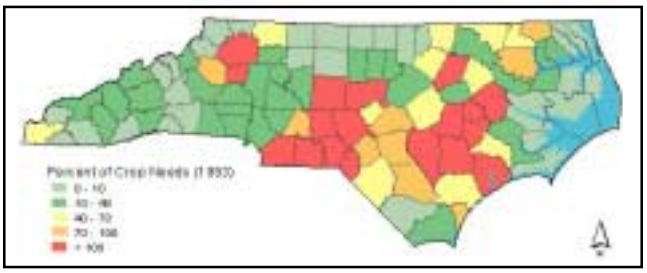

Figure 6. Percent of 1993 crop P needs met by manure in different counties in North Carolina. (Source: Department of Soil Science, North Carolina State University.)

acreages with nutrient demands, costs of transporting manure, and infrastructure constraints present many challenges for the wise agronomic use of manure nutrients in some states. Yet, others may view the abundance of manure nutrients as resource opportunities.

One useful indicator of nutrient balance is the crop removal to nutrient use ratio (crop harvest nutrient removal/nutrient input). Some states have crop removal to fertilizer use (R/F) ratios for P and K *above* 1.0, which indicates crop harvest removal exceeds fertilizer inputs (**Table 1**). When the balance is calculated with consideration of recoverable manure, most states in the Southeast Region have P and K crop removal to fertilizer-plus-recoverable manure (R/F+M) ratios much *below* 1.0. This indicates soil P and K levels should be building. In spite of this apparent surplus of P and K when accounting for recoverable manure, there is still significant opportunity to increase soil fertility on many fields and soils in each state.

Table 1. Crop removal/nutrient use ratios in the Southeast Region states (average 1998-2000) and percentage of soil samples testing medium and below in extractable P and K (fall 2000-spring 2001).

	P			K		
State	R/F[1]	R/F+M[1]	Medium or below, %[2]	R/F	R/F+M	Medium or below, %[2]
Alabama	0.34	0.20	79	0.63	0.46	44
Arkansas	1.15	0.63	37	1.18	0.83	68
Florida	0.43	0.37	51	0.64	0.60	72
Georgia	0.37	0.27	61	0.59	0.47	60
Louisiana	0.98	0.86	58	1.03	0.95	57
Mississippi	1.08	0.66	60	1.29	0.95	38
North Carolina	0.56	0.25	31	0.57	0.36	29
South Carolina	0.50	0.32	46	0.52	0.43	51
Tennessee	0.66	0.57	60	1.11	0.98	51
Average	**0.67**	**0.46**	**54**	**0.84**	**0.67**	**52**

[1]R= Crop removal, F= Fertilizer use, M= recoverable manure.
Source: Plant Nutrient Use in North American Agriculture (PPI/PPIC/FAR, 2002)
[2] % of soil samples testing medium or below in P or K.
Source: Soil Test Levels in North America–Summary Update (PPI/PPIC/FAR, 2001)

This is readily apparent from the relatively high percentages of soil samples testing medium or below in P or K in each state, based on recent soil test summary information (fall 2000 through spring 2001) gathered by PPI scientists from public and private soil testing laboratories. **These soil test summary data clearly show that there is still a tremendous need for P and K inputs on many fields and farms.**

Some have thought that crop nutrient harvest removal to nutrient input ratios below 1.0 (nutrient surplus) would be reflected as generally higher soil test levels, and there would be a low percentage of sampled soils having medium or lower soil test P and K levels. A comparison of the numbers in the Southeast Region states shows there is no relationship between the percentage of soil samples testing medium or lower in P and K and their R/F ratios (**Figure 7**).

Neither is there a relationship between the percentage of soil samples testing medium or lower in P and K and the P and K R/F+M ratios (**Figure 8**). A lack of relationships between the removal to input (R/F and R/F+M) ratios and the percentages of soil samples testing medium or lower in P or K indicates that the native soil fertility in much of the region is low or below optimum and in need of improvement.

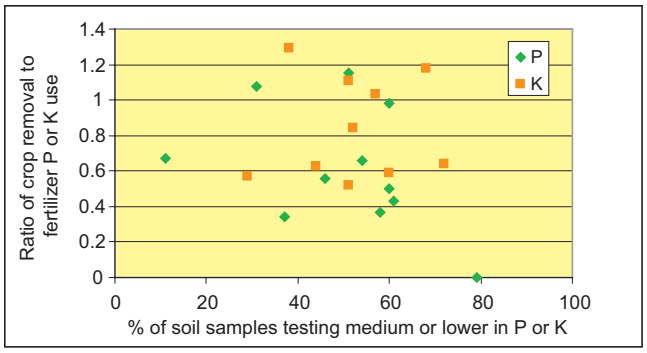

Figure 7. Relationship between the percentage of soil samples testing medium or lower in P or K and the ratio of crop removal of P and K to fertilizer P or K consumption in the Southeast Region states.

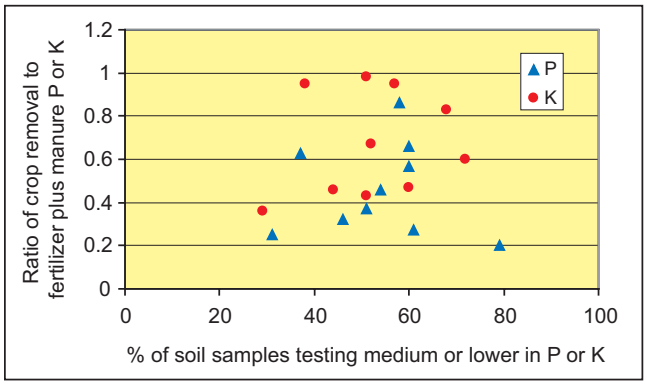

Figure 8. Relationship between the percentage of soil samples testing medium or lower in P or K and the ratio of crop removal of P and K to fertilizer-plus-recoverable manure P or K consumption in the Southeast Region states.

In the future there will be:

- increasing challenges to more efficiently utilize manure resources, based on sound agronomic, economic, and environmental considerations;
- opportunities for increased fertilizer N, P, and K applications on fields where manure resources are not accessible, or where manure use is not economically feasible;
- challenges to provide balanced soil fertility and balanced plant nutrition with manure resources alone, because manures have nutrient ratios different from plant food requirements, and they do not release nutrients at rates as predictable as fertilizers;
- increased opportunities and needs to provide nutrient management planning, with consideration of all nutrient resources on the farm, and manure nutrient resources off-farm that may be within an economic transport distance.

The challenges of preventing and correcting environmental problems, and the opportunities to find economic benefits with improved nutrient management are before us. With improved management, technological advances, and dedication to cooperation, we can continue to provide a safe, abundant supply of nutritious food and fiber to meet the needs of a growing population and world economy. To achieve farm profitability and environmental stewardship goals, farmers, animal industry integrators, fertilizer dealers, fertilizer manufacturers, crop advisers, researchers, and educators will need to work together.

One way for farmers and their crop advisers to meet some of these nutrient management challenges is to consider using the new electronic tool called ***PKalc*** (v.1.13), a simple nutrient balance calculator, recently introduced by PPI. ***PKalc*** is an Excel spreadsheet which helps users determine if P and K additions are keeping up with removal by crops. It can be used for a single year or single crop, and it can enable development of a multi-year, multi-crop nutrient budget. Users of the tool can enter crops grown and yields, plus a list of nutrients added as fertilizer and/or manure. ***PKalc*** then estimates total crop P and K removal and calculates total nutrient additions and the resulting net P and K balance. The estimated net P and K balances get farmers and their crop advisers thinking about whether their nutrient management programs are meeting their goals. The Excel spreadsheet, quick-start guide, user's manual, and examples can be viewed and downloaded from the website:
>http://www.ppi-ppic.org/toolbox< ■

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