



Why Nutrient Budget Maps?

Introduction

Mosaic has been communicating a balanced crop nutrition story with the media and dealerships for the last two years. Our goal has been to assist valued customers understand that N, P, and K need to be available in the correct amounts to achieve consistently high results. Once these key nutrients are met, the addition of sulfur and selected micronutrients can take your yields to the next level. Yield levels on all major crops have been increasing over the last decade, yet many growers continue to fertilize the same as they did in the past. Crops are removing nutrients from the soil at an increasing rate. Soil test levels that were once in the very high category have sometimes dropped to the high or even medium category. Soils testing below the critical levels may lead to significant yield loss and will be very costly to build and restore the soils to their most productive level.

University studies show that 40-60% of yield increases are the result of soil fertility management. This includes applying the right product at the right rate in the right place at the right time – commonly referred to as the 4R's of nutrient management.

The remainder of this print material focuses on the components and questions that you or your growers may have on the information shown in your 12 map packet.

Why are nutrient removal/budget maps a valuable decision tool?

Development of fertilizer recommendations can be a complex decision process if growers want to maximize profits from plant nutrients. Factors such as soil tests, yield goals, soil physical and chemical properties and economics all play a role in the recommendations. Nutrient removal trends also have been used extensively in this process. This is why Mosaic, in cooperation with IPNI, has assembled the enclosed 12 nutrient removal/budget maps for your trade area. The maps are meant as a tool to get the grower talking about nutrient trends in his field. The information can be combined with soil tests, yield maps, and economic analysis for final recommendations for the field.

How are the maps created? What basic information was used to create the maps?

The data includes 2006-2008 average crop yields for the top 5 crops grown in a county and reported fertilizer usage and manure application from 2007. Nutrient removal coefficients from IPNI are found in the enclosed table. Data used to generate the maps came from a multitude of sources: State boundaries: ESRI. Fertilizer use numbers were estimated using data from AAPFCO, 1987-2007. Crop removal and recoverable manure nutrients were calculated using data from: Census of Agriculture 1987-2007 USDA/NASS; NASS Quick Stats, 1966-2008 USDA/NASS, and various state and regional NASS/ERS/USDA publications. Nutrient use and removal rates by crop: IPNI.

The enclosed maps bring the information to a more localized level. You will find a set of 12 maps and a summary table by crop and county. There is a map code in the lower left hand corner for reference. For example, map code *4000001_5007894_03*, the last two digits (03) refer to Map 3 or the K removal map for average yield in the county. As an initial run, we pulled data from a 50-mile radius from your ship-to location to create the maps. You will find a reorder sheet in the packet if you would like us to rerun the maps with the counties that fit your specific trade area.

What are the 12 nutrient removal and budget maps?

Maps 1-3: Crop removal using a 3 year average yield

Using phosphorus (P) as an example: Map 2 shows the total amount of product (DAP) removed from the fields using crop or grain removal data. It is calculated by multiplying harvested acres x yield x the P removal coefficient for the top 5 crops in each county. Pounds of P_2O_5 are then converted to tons of DAP for each county. The first number under each county name is tons of DAP removal potential for the county. The second number is average P_2O_5 removal rate per acre. The box at the bottom of the page lists the total harvested acres in the counties, tons of DAP removed and overall average lbs P_2O_5 /harvested per acre. County numbers were rounded to calculate the total harvested acres and tons of product removed. These rounding errors can generate a slight difference in the calculations due to the large number of acres involved. The map gives an indication on the potential size of the market for selected area. The tons of product removed number does not consider soil or manure contributions, only plant removal. The N and K maps are created in a similar process with removal expressed in tons of urea or potash.

Maps 4-6: Crop removal using a 3 year average yield adjusted for 20% increase in yields

Maps 4, 5 and 6 are designed to show the crop removal numbers and potential for farmers who have yields that are 20% higher than the county average. These tend to be the more progressive farmers who are more innovative and continually push for higher yields.

The first 6 maps are intended more for the dealership than the farmer. They can be used as a guide to estimate total nutrient requirements in your trade area. They can give you a rough idea of your market share. Keep in mind that these numbers represent total tons of product equivalent removed.

Maps 7-9: Nutrient budget (3 year crop removal minus fertilizer applications)

Map 9 shows the Potassium (K) budget or balance. The values are obtained by subtracting nutrient removal from nutrient applications. Positive values (green) indicate a surplus of nutrients being applied (building the soil). Negative values (red) indicate a draw-down or deficit of nutrients (mining the soil) and will have a minus sign in front of the number. N and P budgets are shown in maps 7 and 8.

Map 10-12: Nutrient budget (3 year crop removal adjusted for 20% increase in yields minus current fertilizer applications)

Maps 10, 11, and 12 show the nutrient budget numbers for farmers who have yields that are 20% higher than the county average.

Maps 7-12 could be used with a grower depending on their historic yield levels compared to the reported county averages. The appropriate maps could show growers how they compare to county averages for both yields and fertilizer application rates. If they are under applying, it creates an opportunity to back up the rationale for applying more. If they are building the soil, you can show them the benefits of having higher soil test levels to achieve higher yields.

Page 13 shows the tabular data for the top 5 crops and yields for each crop by county. Other information in the table includes harvested acres, average county yield, yield plus 20%, and the N, P, and K removal coefficients for each crop in the county. Keep in mind this is removal, not uptake.

What are the limitations of these maps?

1. Nutrient removal maps are based on county yield averages from USDA times a nutrient removal coefficient per unit of yield. If the grower's fertilizer application philosophy has been to apply removal rates, then the budget maps will show that the system is approximately in balance. In reality, we expect to use the maps to show trends of mining or building soil nutrients and not as the final decision on rates per acre. Having a soil test to monitor soil nutrient trends will complement this map data.
2. If the soils in your area test high because of manure application or the soil nutrient levels are naturally high, the map colors showing a deficit budget may be red since removal rates will exceed application rates. For example, the western corn belt soils typically are high in soil test potassium. The K nutrient budget map for this area will be red because farmers apply low rates of potash versus crop removal levels.
3. Fertilizer and manure applied by county are calculated from USDA and AAPFCO databases. If counties do not report the data accurately, the fertilizer applied may be distorted. Also, consider that some counties have large fertilizer warehouses that ship to other retailers in different counties, so the fertilizer application may not be credited to the right county. These examples, in most cases, are isolated.

How should we use the Maps with growers?

1. The goal is to use the maps as a tool to generate discussion between the dealer and farmer on N, P, and K rates. In most cases, the high yields of the past 3-5 years are removing more nutrients than most farmers realize and adjustments are needed to maintain or increase their yields.
2. One set of maps (Maps 7-9) are based on county average yields. Your table in the packet will provide you with the county yield average (2006-2008). These maps can be used with growers in that yield range. The second set of maps (Maps 10-12) are average yields plus 20%. Use these maps with your high end growers.
3. We suggest you use the reorder form or call to get additional sets of maps for each of your farm call staff.

- We recommend that you join a Mosaic on-line training session on September 21 for more background information on maps and ask additional questions. You will receive a post card with dial-in information and times.

How long can I mine the soil?

There is no simple answer for how long growers can mine the soil before seeing yield loss because the nutrient draw down rate will vary depending on initial soil nutrient levels, soil texture, pH and other factors.

The value of soil testing is to measure trends over time although it is used for other purposes. The following is a summary of the relative value of information provided by soil testing.

Relative Value Of Information Provided By Soil Testing (Source: Leikam AgroMax)

Soil fertility status over time	Very Good
Probability of yield response	Very Good
Relative long-term yield averaged over a number of years	Good
Average long-term optimum nutrient application rate over a number of years	Fair-Good
Relative yield for specific field in individual year	Fair
Optimum nutrient application rate for specific field in individual year.	Fair-Poor

Using a checkbook / nutrient removal approach, this can be combined with soil tests to monitor nutrient levels in the field. For example, benchmark amounts of 18 lbs of P_2O_5 are needed to raise soil P one ppm and 8 lbs of K_2O are required to raise soil K one ppm. These same amounts of P_2O_5 and K_2O removed in grain will lower soil test P and K. The critical soil test levels for P and K vary by states, but 20 ppm P and 165 ppm K are commonly used numbers.

Take an example where a grower has a soil P soil test level of 28 ppm and applies no phosphorus fertilizer or manure. A 200-bushel corn crop will remove 76 pounds of P_2O_5 /acre. When divided by 18, he would expect his soil P levels to decline by 4.2 ppm in that year. In a continuous corn system, if no phosphate fertilizer was applied, he would be below the critical level after the second year. Most growers will cut back instead of not using a nutrient at all. You can use the same formula to calculate the drawdown rate and time to reach the critical level.

Long term effects of annual phosphate application rates on soil P levels

P ₂ O ₅ rate	Initial soil P	After 1 year	After 3 years	After 5 years
76 #	28 ppm	28 ppm	28 ppm	28 ppm
50 #	28 ppm	26 ppm	23 ppm	19 ppm
0 #	28 ppm	24 ppm	16 ppm	8 ppm

As mentioned above, the maps do not consider existing soil test levels for each nutrient. A negative number may not be an issue if soil test levels are already high. You can calculate the net removal rate and predict the number of years until critical levels are reached.

As noted at the beginning, this tool is meant to be used to generate a conversation between the grower and the dealer and review current fertility practices and possible modifications.

We look forward to your feedback.

Mosaic Agronomy Team