What's in your nitrogen budget?

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Nitrate fertilizer management is under intense discussion in California. A newly released report by the University of California has documented the widespread presence of nitrate in groundwater in major agricultural regions (groundwaternitrate.ucdavis.edu). As a result of these studies, state regulatory agencies are now proposing a variety of steps to help improve nitrogen fertilizer management.

With closer scrutiny on nitrogen fertilization practices, farmers are being asked to balance the inputs of nitrogen on each field with the amount of nitrogen removed during harvest. This is similar to balancing a checkbook where all deposits must be reconciled the withdrawals. You will be hearing more about how to do this for your clients in the coming months.

Before you begin to construct your nitrogen budget, the first step is to estimate a realistic yield for each field and crop. This allows you to calculate how much nitrogen will be removed in the harvested crop. Remember that it will take more nitrogen to grow a plant than the quantity removed in the harvested portion since leaves, roots, and other plant parts are often left in the field. The website http://plants.usda.gov/nph/main is useful in estimating nutrient removal during harvest.

Nitrogen Inputs to Know:

• Residual nitrogen in the soil. Soil testing will provide valuable information on how much nitrate is present in the rootzone before you begin the growing season. Be sure to consider where the growing roots will be and then sample in this zone. Always try to keep the amount of residual nitrate in the soil as low as possible when there is no active plant growth.

• Nitrogen release from crop residue, manure, and soil organic matter. Organic matter will slowly release nutrients during the growing season. Some organic materials will release nitrogen very quickly (a week or two), while other materials (such as stable composts) can require months or years to release their nutrients. Release of nitrogen from soil organic matter is a slow and steady process in most California agricultural soils.

• Irrigation water may already contain significant amounts of nitrate. The amount of nitrate added with the water during the growing season should be considered in the total nitrogen supply. Using nitrate in the irrigation...
water is sometimes called “pump and fertilize”. Be sure to have the irrigation water analyzed to know what you are adding. Each ppm of nitrate-nitrogen contributes 2.7 pounds of N with each acre foot of water (for example, irrigation water with a concentration of 10 ppm nitrate-nitrogen would supply 27 lb N in one acre foot of water).

• **Nitrogen fertilizer makes up the difference to meet crop demand.** Once all the sources of nitrogen are accounted for, the remaining crop requirement can be met by added fertilizer. Not all of the added fertilizer will end up in the crop since there are always some unavoidable losses, but these can be kept to a minimum.

You already know that there is a lot of skill and art required to manage fertilizer nitrogen. This involves using your local expertise to decide issues such as:

**Right Source:** Nitrogen fertilizers are most commonly supplied as nitrate, ammonium, or urea. Each one of these behaves differently in the soil. You may want to consider if some of the nitrogen inhibitors (urease inhibitors or nitrification inhibitors) may work for you to keep nitrogen in its place. New controlled-release fertilizers may also provide some excellent management options.

**Right Rate:** This can be a difficult number to define. We have good general recommendations from sources such as the University of California, but fields often have low and high-yielding areas and then yields may fluctuate due to weather or alternate bearing factors. Careful record keeping over multiple years will help document realistic yield goals and in developing an appropriate fertilizer plan. Using tools such as soil nitrate testing, petiole analysis, or tissue testing will provide valuable feedback during the growing season with which management decisions can be made.

Even simple practices such as periodically calibrating the fertilizer spreader or performing maintenance on fertilizer injection equipment will make sure the right rate is being added.

**Right Time:** Do you need an application of starter fertilizer and what type of nitrogen is most appropriate (urea, ammonium, or nitrate)? How will the crop respond
to split applications of N? How many splits are desirable or feasible? When does the crop have the greatest demand for nitrogen? Applying nitrogen too early or too late for the specific crop will result in lost yield, reduced quality, and wasted fertilizer.

**Right Place:** Plant nutrients need to be near the roots to be effective. Some nitrogen sources move easily with water, while others are less mobile. Are you using water to move the nitrogen to the root zone? If so, don’t over-irrigate or else nitrate can be pushed below the root zone and be lost. It is not practical to use foliar fertilization for the majority of the crop requirement, but it may have a role in fine-tuning plant nutrition during the growing season.

**Watch your irrigation practices:** All the careful attention to nitrogen management can be cancelled out by misapplication of irrigation water. Nitrate and urea are very soluble and move freely with water in the soil. When irrigation water moves past the root zone, it carries these nutrients with it. Meeting plant water demands while avoiding nitrogen leaching is very challenging, especially with shallow-rooted crops. Extra water additions for salt management should take place after the growing season when nitrate concentrations in the soil are at their lowest. Appropriate irrigation and careful nitrogen management are inextricably linked.

We will be hearing much more about nitrogen management in the years to come. Take time to review these fundamentals so you will be ready to help your clients with their crop nutrition needs.

Newly transplanted vegetables initially have a low nitrogen demand. Nutrients should be applied so they are available at “the right time” (when plant demand is high) to avoid unwanted losses.