Title of the Practice: Nutrient Management – National Resources Conservation Service (NRCS) Conservation Practice 590

Definition: managing the amount, source, placement, form and timing of the application of plant nutrients and soil amendments.

Purposes: On organic farms, nutrient management is associated less with the provision of specific nutrient inputs at prescribed rates and more with the holistic management of soil quality and health. The National Organic Program (NOP) Rule, Section 205.203, out­lines general goals for organic production. Suggested guidelines (205.203 a,b,c,d) that relate to nutrient management include:

* Select and implement tillage and cul­tivation practices that maintain or improve the physical, chemical, and biological condition of soil and mini­mize soil erosion.
* Manage crop nutrients and soil fertil­ity through rotations, cover crops, and the application of plant and animal materials.
* Manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not con­tribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.

These guidelines are well-aligned with NRCS nutrient management goals, which are to budget and supply nutrients for plant production, properly utilize manure or organic by-products (biosolids are not permitted by NOP rule) as plant nutrients, minimize agricultural nonpoint source pollution of surface and ground water resources, protect air quality (by reducing nitrogen (N) emissions and the formation of atmospheric particulates) and maintain or improve soil quality.

Organic growers base nutrient budgets on realistic yield expectations. However, the algorithms used to quantify crop nutrient needs are somewhat different than for calculating nutrient inputs for conventional vegetable production. A basic premise is that high quality soils can meet yield expectations with less nutrient input; i.e. lower application rates of N, P and K. Enhanced soil microbial activity, mineralizable soil organic N and microbial biomass-N as well as better soil physical properties are believed to be associated with this phenomenon. In addition, organic growers believe that excessive levels of fertilizer application can lead to nutrient imbalances.

 In any event, a nutrient plan (budget) for N, phosphorus (P) and potassium (K) is developed for an organic system plan that considers all potential sources of nutrients including animal manures and organic by-products, waste water, commercial fertilizer, crop residues and legume credits. Through experience, some combination of these components is matched to yield expectations.

Where organic fertilizers are used, they are commonly lower analysis. Two commonly used complete organic fertilizers are Harmony 5-4-3 and Perdue AgriRecycle MicroStart 60 4-2-3 (or MicroStart 60 Plus, 7-1-1). The latter are pelletized poultry litter. Higher analysis choices are feather meal at 13-0-0 and Chilean nitrate (limited by the NOP to 20% of a total N crop fertility “package”) at 16-0-0. On a “unit value” basis, these fertilizers are more expensive than conventional fertilizers, and this contributes to conservative application rates. Commonly, they are used as “starter” fertilizers, particularly when environmental conditions can be expected to limit (or slow) the release of nutrients to crops from organic fertilizers, amendments or residues.

Another important consideration for organic growers with respect to N application rates is weed response to N application. As herbicides are prohibited, growers are sensitive to “fertilizing weeds,” particularly early in the growing season. Fertilizer placement in the row (banding) is a practice employed to favor crop over weed. Transplants rather than seed are a favored option to utilize applied N and achieving a “head start” on weeds.

With respect to soil testing, organic growers recognize that soil tests provide information on soil chemical condition, but that soil physical and microbiological ecology are equally, if not more important, factors in determining soil fertility. In the Carolinas, it is important to remember that soil test N recommendations are based on linear regression models of crop response to N application rates “in the absence” of other variables that affect soil quality and fertility such as soluble organic carbon and N.

Soil test results are instructive for assessing soil P availability. Where organic farms have a history of conventional tobacco production soil P index values (P-I) can be in the “high” or “excessive” range. The same is true where there is a field history of poultry litter use. On the other hand, where fields have not been managed or have been recently brought into production, P-I can be very low. In the former case, a PLAT or PI evaluation is called for, particularly on soils with significant slope. In the latter case, grower options are limited with respect to organic fertilizers. Rock phosphate, commonly used to address P deficiency on organic farms, typically has only 3% available P, meaning that significant additions of rock phosphate are required to build soil P levels. If poultry litter is available, the available P in that material (46 lbs/acre incorporated) may make it a good choice for addressing low P. Again, a PLAT or PI analysis would be recommended before application and incorporation of the product. When using litter, soil Cu, Zn and arsenic (As) availability will influence grower decision-making with respect to whether or not to use litter and application rate.

For N and P recommendations based on PLAT assessments and for criteria determining when PLAT and additional assessment tools are required, see: <http://efotg.sc.egov.usda.gov/references/public/NC/590fieldrelease08_acidicsoils_starterPfeb09.pdf>.

NOP requires any manure application to be made at least 90 days before harvesting a crop whose edible portion would not be contacted by manure and 120 days before harvesting any crop whose edible portion would be likely come into contact with manure (certifiers may view this dichotomy differently). Manure that has been composted is not subject to these requirements provided that it meets certain processing regulations (15 days, five turnings, temperatures between 131 to 170 degrees F).

Note that in most cases, organic growers would consider compost to be a soil amendment rather than a fertilizer, because of the relatively “stable” nature of the material. Many organic producers subscribe to a “feed the soil” philosophy, and compost is a major feedstock, providing an energy source to drive soil microbiological systems. A thriving microbial ecology is believed to be an essential component of plant health and resistance to pests and environmental stressors.

A foundation of soil fertility practices on organic farms is the inclusion of cover crops in rotations. A discussion of the benefits of cover cropping is beyond the scope of this document. Growers use cover crops to accomplish all of those benefits. Principally, cover crops are used to fix atmospheric N, recycle residual nutrients and contribute to soil organic matter content.

A winter annual cover crop containing a legume/small grain biculture is a fundamental nutrient management strategy. Hairy vetch, crimson clover and Austrian winter pea are common legume choices in combination with cereal rye or oats. The latter is the preferred choice before early spring vegetable crops, as is crimson clover, which matures about four weeks earlier than hairy vetch. When termination can be delayed until mid-May, a biculture of rye and hairy vetch will produce the most biomass and biomass-N of any combination. However, the availability of equipment on the farm to manage that additional biomass and resulting residue will influence cover cropping decisions. Because no-till organic vegetable production is still considered a risky management choice, most growers would plan on incorporating residue, making field preparation challenging when aboveground biomass is heavy. Incorporation issues can be addressed through legume monocultures. Crimson clover planted alone can still contribute significant biomass and biomass-N and is relatively easy to kill and incorporate. It is a good choice when experimenting with no-till planting a subsequent crop.

Species, planting date termination date and weather all influence the amount of N fixed by a winter annual legume. The standard (default) residue values included in the RUSLE2 algorithms may vary considerably from actual results in the field. This is especially the case when bicultures have to be “manufactured” by pairing two separate winter annual crops in management scenarios.

In summer, given a sufficient window of opportunity, cover crops are grown primarily to recycle nutrients, provide organic matter and prevent erosion. That said, there are summer annual legumes which can fix significant N in a short period of time. Commonly planted summer legumes include cowpeas and soybeans, though the latter is very attractive to deer. These are often grown in a biculture with a short-statured millet such as foxtail or Japanese millet. A relative new choice is sunn hemp (*Crotalaria juncea* L.) which can fix 100 lbs/A of N in less than 60 days. A primary impediment to the use of sunn hemp has been the cost; however, that price has been coming down, particularly when purchased in bulk quantities.

Non-legume choices for summer planting include hybrid sorghum sudangrass and pearl millet. These grasses grow quickly and convert recycled nutrients into abundant biomass. Both can be harvested as forage for livestock. Note that because of the rules regarding preharvest intervals when applying manure, in most cases these forage crops could not be grazed before planting fall crops.

Buckwheat is a favorite summer crop on organic farms. Almost all organic farms will include buckwheat in the rotation to attract beneficial insects. Though it doesn’t produce much biomass, that fact that it germinates and establishes quickly (even when surface broadcast) and matures in four weeks makes it a niche “performer” in almost any operation.

Operation and Maintenance: Good producers keep good records. The organic system plan (OSP) that the NOP requires for each organic farm requires nutrient and rotation plans. Most rotations would include at least one cover crop annually. Seasoned organic producers with a sufficient land base will have six to eight year rotations. These longer rotations often include a two or three year “rest” with perennial legumes, grasses and forbs planted for soil building purposes. These longer rotations align well with goals of the EQIP Organic Initiative and provide opportunities for organic producers to work with DC’s in their respective counties.