United States Department of Agriculture
Agricultural Marketing Service
National Organic Program
Transition to Organic Partnership Program

Oxbow Farm & Conservation Center

Fertility Guide Companion

Find the tool template that goes along with this guide here:

https://cms.organictransition.org/wp-content/uploads/2024/04/Organic-Fertility-Guide-Template.xlsx

1. The purpose of this guide is to support farmers and growers to understand how much fertilizer to apply throughout the year to better manage crop and soil health and prevent nutrient leaching. There are many ways to use these tools based on what makes most sense for your system and invite and encourage folks to adapt these documents to best fit your farm.

2. The fertility guide is best used to translate nutrient recommendations on a soil test to practical applications of fertilizers. This guide was developed on and for Organic farms and farms implementing organic practices and we use it to account for both fast and slow-release fertilizers. We did not include instructions for interpreting numbers in a soil test to recommendations partially because we found it more cost effective to order tests with recommendations rather than calculating ourselves. When we calculated in the past, the amount of extra time used to determine recommendations cost more than having recommendations incorporated in our testing.

3. This guide does not capture all the sources of potential plant available nitrogen (PAN). We included a very rough guideline covering how we account for PAN from compost applications and cover crops though it requires additional testing to understand ammonium, nitrate, and total N, percent N, etc. through either soil tests or plant tissue samples. We included a basic N budgeting worksheet that can be used to provide a fair estimate of how much PAN we can expect from other organic practices.

    a. **Compost:** Because of the cost, we apply compost on a rotational basis, once every few years and incorporate compost as a biotic inoculant rather than a reliable nutrient source. It is important to note the overarching benefits of compost aside from nutrient release and highly advise the use of compost as a component in a larger soil health management program. Understanding Estimated Nitrogen Release (ENR) from compost is highly variable and can differ from batch to batch. On average we can expect about .5 - 2.5 percent total N based on the dry weight of compost (Clemson, 2024). Of the total Nitrogen there are two forms that are plant available, ammonium and nitrate. As compost ages and matures, ammonium levels decrease and are oxidized to nitrate. The nitrate in the soil is very volatile and is prone to leaching, off-gassing, and/ or is consumed by organisms decomposing organic matter. We further expect only about 10% - 30% of the nitrogen in the organic compounds to be available in the first growing season. This slow release continues with the remaining nitrogen over the course of many years at an increasingly slower rate (Mangan et. Al, 2013). All this to say compost is not your most reliable source of nitrogen but is highly beneficial and we are huge fans.

        Understanding Phosphorus and Potassium release from compost is far simpler. We can on average expect about 1% of the dry weight of compost to be Potassium and

Phosphorus. Phosphorus in compost is like Nitrogen in that it is incorporated in organic matter and is thus not readily available. Further, not all phosphorus mineralized is available for crops since some of the phosphorus released by microbial and chemical

action binds with other elements in the soil (Mangan et. Al, 2013). Like Nitrogen, we recommend providing additional sources of phosphorus through Organic fertilizers to

provide enough nutrients for optimal soil and crop health.

Potassium from compost is more readily available and would average about 1%; if compost is applied as a means to address potassium needs or applied in large quantities we encourage soil tests to understand the exact percentage and how it contributes to the overall fertility. Remember that Potassium is soluble so the more compost is covered when stored (specifically over winter or rainy months) the less leaching will occur.

We again use compost regularly as part of our larger fertility and soil health management plan, but we don't typically think of it as a large contributor to our overall yearly nutrient management plan or fertility guide. We do fall applications in our rotational fallow/ cover crop fields prior to a fall cover once every few years to increase organic matter, provide a food source for microorganisms and bacteria, increase soil organic carbon, and numerous other benefits. This does have a large impact on our overall soil health and fertility but on a year-to-year basis, since our application is infrequent and in smaller quantities, many of the nutrient release from compost is accounted for in our early spring soil tests. My intention in explaining the above is not to dissuade the use of compost but rather to encourage use and manage expectations of what all we are gaining when applying compost and encourage the use as one of many tools to improve overall soil health and quality. If applying compost in large quantities, either as a deep mulch, or as a pre-plant application, we do encourage calculating and accounting for nutrient release when developing a nutrient and fertility management plan.

b. **Cover Crop:** Incorporating cover crops in your cropping system, depending on mixes, timing, etc. can significantly off set your Nitrogen and fertilizer applications on a yearly basis. It also plays a large role in erosion control, building and maintaining soil structure, increasing soil organic matter and carbon, and scavenges for nutrients preventing leaching, among many other benefits. The main goal in calculating nutrient release from cover crops is to save costs on additional fertilizer and to fine tune your ability to adequately increase crop and soil fertility. Calculating and determining Nitrogen release from a cover crop depends on many variables.

   For Nitrogen release, not all cover crops are equal. For example, with a strong stand we can expect upwards of 100 lbs./ A from a legume cover crop, meanwhile if our ratio or percentage of cereal grains are high we could find an overall loss of N, meaning we'd have to increase fertilization to account for N locked up by decomposing cereal crops. The importance of finding the right mix and varieties for your system and a mix that meet your goals is very important in deciding what cover crop to produce. We often

have a few different mixes in our fields depending on what was grown the year prior, what will be grown the next year, and based on some of our multi-year goals for the different areas.

Timing proper termination is extremely important and becomes more of a give or take. To maximize for N release from a cover crop you want the legume to be in peak bud stage to peak bloom. For cereal grain, peak PAN is through the tillering stage (when side shoots develop) with a steady decrease through stem elongation. Once the flag leaf emerges PAN is nearly zero and when cereal heads are visible, PAN is negative (Sullivan, et. Al, 2020). We aim to terminate and turn in cover crops at early to peak flowering of our legume and ideally just prior to boot stage (when the seedhead swells below the flag leaf). Our main goal is to terminate before seed set and ideally before head development. This is of course our goals and the practical reality of achieving perfect termination times for all our cover crops does not always align with our production and distribution goals.

i. **Estimating PAN from Cover Crop (there is a guide in the workbook)**
   a) Create a 3x3 quadrant out of PVC or other materials.
   b) Place over cover crop and cut at ground level.
   c) Dry and weigh, that number is: 'X'
   d) Calculate overall biomass of cover cropped field = ('X' / 9ft.^{2}) x 43560 ft.^{2}
   e) Send the dried sample into the lab to understand %N
   f) Multiply %N in dried sample with your cover crop's overall biomass.
   g) Calculating PAN from a cover crop is highly variable as well. It's easiest to estimate from the C:N ration. If the C:N ratio is high, you can expect less PAN, if it's too high it could mean a N deficiency to for microorganisms to fully breakdown the Carbon material. For the guide we simplified the equation to roughly 20% of the Total N being PAN. It typically ranges between 4%- 35%. It's important to also note that if you have too many cereals in a cover crop (60-70% and up) you shouldn't expect any PAN from the cover crop. *This is another current limitation of the tool*
      i) (Lloyd, 2019)

It is also very important to note that PAN from a cover crop typically peaks between 4 and 10 weeks, so understanding timing of termination with supplemental fertilizations and planting is useful to get the most benefit from your cover crop. We will factor in estimated PAN for preplant fertilizations, which is particularly useful when calculating for crops like brassicas where N uptake is relatively low until it hits the rosette stage at which point N uptake rises.

Cover crops are among the most important practices for our soil health management plan. They are invaluable in addressing a myriad of growing challenges and in building and maintaining a healthy and resilient soil. As with everything in this guide we encourage you to explore how to best incorporate into your operation and do what makes most sense for your systems. We work with a lot of summer cover crops, inter-seeding, over sowing, and have numerous complex mixes throughout the farm.

Incorporating all these practices may not make sense for all operations and we want to encourage to find out if and how cover crops can work with your system.

4. This guide can be used to account for one single application at preplant or can be augmented to account for supplemental applications to time release when the plants need them. The benefit

   of split applications is applying nutrients at growth stages when crops need them most. Further, if all nutrients are applied pre plant it increases the risk of nutrient leaching. We are experimenting with side banding with planet jr.s at rosette stage for brassicas but find fertigation to be a bit easier and cost effective for our system.

5. We hope this guide is helpful and we would love to hear any feedback you have when using. We are always wanting to improve our systems and our resources. Please feel free to email farmers@oxbow.org with any questions or feedback.

Bibliography

Dan M. Sullivan, N. A. (2020, August). *Estimating Plant-Available Nitrogen Release from Cover Crops*. Retrieved from OSU Extension Servie: https://extension.oregonstate.edu/catalog/pub/pnw-636-estimating-plant-available-nitrogen-release-cover-crops

Frank Mangan, A. B. (2013, January). *Compost Use and Soil Fertility*. Retrieved from UMass Extension Vegetable Program: https://ag.umass.edu/vegetable/fact-sheets/compost-use-soil-fertility

Lloyd, M. (2019). *How Much Nitrogen is in your Cover Crop?* Retrieved from University of California Cooperative Extension: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ucanr.edu/sites/soils/files/310425.pdf

Services, C. R. (2024). *Compost Interpretation*. Retrieved from Clemson Ag Service Lab: https://www.clemson.edu/public/regulatory/ag-srvc-lab/compost/interpretation.html#:~:text=Nitrogen%3A%20Total%20nitrogen%20includes%20organic,2.5%20on%20a%20dry%20basis.