Organic Transition Series

FACT SHEET

Soil Fertility Management for Organic Grain Production

Successful fertility management to attain crop yield and quality goals is achievable even as organic farming requires diverse inputs. While USDA organic regulations prohibit the application of synthetic inputs, strategies allowed under certified organic management include naturally-derived amendments, manure, and cover crops. Providing adequate fertility while building soil quality and reducing input costs typically relies on a multi-faceted, long-term systems-based approach across a diverse crop rotation.

As with conventional grain systems, fertility management in organic grain systems requires regular soil testing and addressing deficiencies. However, due to the lower nutrient concentrations characterizing organic approved products, slower availability of nutrients after application, and the cost and availability of off-farm inputs, organic fertility management must be thought of as a long-term investment. Decisions regarding soil amendments, including the potential addition of soil-building phases of the rotation, should be considered carefully as to their return on investment in the short term and over years.

What do organic grain farmers use for nitrogen fertility?

In order to meet crop nitrogen (N) needs, organic grain farmers often rely on three primary strategies: a legume-intense forage crop (including alfalfa or a legume-heavy hay crop), legume cover crops and mixes, and manure. Depending on the location of the farm and the associated cash crop options and resources, emphases on these three strategies may vary.

An alfalfa crop is a valuable contribution to an organic weed management program in addition to its value to a fertility management program. As a nitrogen-fixing legume, a stand of mature alfalfa can supply a significant portion of a subsequent corn crop N needs after termination. It is important to note, however, that if the alfalfa is harvested and sold off-farm, additional replacements of potassium (K), phosphorus (P), and micronutrients may be needed.

Legume cover crops (often called "green manures") such as clover can provide significant N to a subsequent corn crop. The inclusion of cereal grains strategy particularly easy to fit in between cash crop phases. For example, clover and other legumes can be frost-seed or no-till drilled into a fall-seeded cereal grain crop in the spring. After grain harvest, these underseeded legumes germinate, grow vigorously, and contribute N to the soil through their association with rhizobium bacteria. If frost-seeding in the spring is not an option, legume cover crops can also be planted after cereal grain harvest. Rotations with legumes as cash crops can also reduce the need for imported N across the rotation, thus decreasing input costs. These may include soybeans, lentils, dry edible beans, and field peas. While N contribution to the system will vary, they do decrease the overall need for purchased N when considering costs of production.

Non-legume cover crops can also play an important role in fertility management. Cover crops, such as cereal rye and buckwheat, can help sequester nutrients such as nitrogen and phosphorus, maintaining them in the soil profile where they can be utilized by the cash crop.

Manure is allowed in organic grain production as a fertility input and can be sourced from either organic or conventional livestock. Direct manure deposition on fields from conventional animals is also allowed, making custom grazing of conventional livestock another attractive option for organic farmers if water and fencing are available. It is also important to note that for food safety reasons, raw manure has to be incorporated at least 90 days before harvest for all grain crops.

If sourced from a conventional farm, it is essential to ensure that no additives, stabilizers, or prohibited substances were added to the manure prior to its application on organic fields. Manure can be procured from a number of sources, including liquid or solid dairy, hog, or poultry manure, among other livestock. Cost and availability of manure will vary depending on region; thus, it is important to consider other strategies, such as legume cover crops, to lower input costs and reliance on purchased products. Sewage and biosolids are prohibited under the organic regulation. Other permissible sources of N include compost, feathermeal, soybean and alfalfa meal, and fishmeal. As price and the nitrogen concentration of these product can vary, it is important to consider the potential return on investment. Prior to applying any product, check the Organic Materials Review Institute list (https://www.omri.org/omri-lists). This list indicates which products are allowed in organic systems. Although the OMRI list is a good indication the product will be allowable, it is still prudent to consult with a certifier prior to applying an input. The ramifications of applying a product that inadvertently contains a prohibitive additive are significant, including the loss of certification for those fields.

Sodium nitrate ($NaNO_3$, 16% N), also known as Chilean Nitrate, is considered a restricted-use product under organic regulations. This product, mined from naturally occurring deposits in Chile and Peru, can be an attractive option due to its relatively high N concentration and the fact that it is readily soluble when added to soil. However, this product is intended for judicial use — it is not to serve as the foundation of a fertility management plan. Operators who opt to use sodium nitrate must apply it in a way that maintains or improves the natural resources, including soil and water quality, and complies with crop nutrient and soil fertility requirements. The use of sodium nitrate is prohibited under some international certification programs (such as Canada), thus an important consideration when selling to an export market. With this input, it is important to consult with the certifier not only on the specific product to be applied, but also the context within which it is being used..

What do organic grain farmers use for potassium and phosphorus fertility?

As with N, manure is the most common source for P on organic farms. However, there are other allowable sources of P for organic production. Rock phosphate, which is mined within the United States, can be sourced as both hard and soft (colloidal) rock phosphates, with soft rock phosphate products having the smaller particle size. While these products can be useful for addressing P deficiencies, a farmer must be aware that this form of P is not immediately available for uptake upon application to the field. For rock phosphate to become plant available, the acidity of the soil solution must dissolve the P into a plant-available inorganic P. Thus, it is also essential to ensure the pH of the soil is below 7 when applying rock phosphate.

Bone meal is another organic-approved source of P. As with rock phosphate, the plant availability of P following the application of bone meal depends on soil pH. Bone meal should be applied to soils that have a pH below 7 to ensure the necessary acidity for the P to convert to plant-available P.

Potassium sulfate (sulfate of potash) is an approved input that can be used to address K deficiencies on organic fields. Potassium chloride (muriate of potash) may be applied such that it is derived from a mined source and if chloride accumulation in the soil is minimized (but it is best to check with the organic certifier prior to application).

What do organic grain farmers use for secondary macro- and micronutrients?

For calcium additions, lime and gypsum products approved for organic farming can be applied. Lime can be applied if it is from a natural, mined source such as calcitic lime (calcite) or dolomitic lime (dolomite). Calcium hydroxide (slaked lime) and calcium oxide (quick lime) are synthetic products and are thus not allowed in organic production. Magnesium sulfate is allowed for amending magnesium levels in the soil. Sulfur can be added as elemental sulfur, or through applications of gypsum and potassium sulfate. Organic-approved forms of most micronutrients (such as boron, zinc, manganese, iron, copper, and molybdenum) also exist; however, prior to application, a soil test needs to document deficiencies in the field to justify their application.

Take-home message:

As with many aspects of organic production, fertility management requires careful planning and a long-term outlook. A successful, cost-effective fertility management plan should minimize the purchase of off-farm inputs, while focusing on building soil health and fertility through the use of cover crops, green manures, legume cash crop phases, and crop rotation. If inputs are needed, a number of products approved for organic production are available.

References and Further Resources:

Wander, M., N. Andrews, and J. McQueen. 2019. Organic soil fertility. https://eorganic.org/node/1471

USDA Agricultural Marketing Service. National Organic Program [Online]. www.ams.usda.gov/nop/

Wander, M. 2020. Soil Fertility in Organic Farming Systems: Much More than Plant Nutrition. https://eorganic.org/node/787

Gaskell, M. et al. 2007. Soil Fertility Management for Organic Crops. https://escholarship.org/uc/item/1ws2d496#main

www.northcentral.sare.org
www.agronomy.org

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture (USDA), under award number 2018-38640-28416 through the North Central Region SARE program under project number ENC18-166. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the USDA.

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