Organic Soybean Production

CURRENT TOPIC

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Organic farmers grow crops without using synthetic pesticides or fertilizers, relying instead on a wide range of cultural practices and alternative inputs believed to be safer for the environment and the consumer. Organically grown food and feed typically command premium prices in the marketplace. Customers look to certification agencies for assurance that the products they buy are produced according to specified standards. For information on organic production and certification, please request the following ATTRA publications: *An Overview of Organic Crop Production* and *Organic Farm Certification & The National Organic Program*.

Soybeans are relatively easy to produce using organic methods. However, it is important to recognize that organic farms rarely focus on a single crop. Organic soybeans are best grown in rotation with several other crops that (ideally) complement or compensate for one another. Organic production is further enhanced when livestock enterprises that involve grazing and generate manure are also part of the system.

Crop Rotations & Fertilization

Being a legume, soybeans furnish most of the nitrogen (N) they require to produce a crop. The soybean is a moderate consumer of nutrients, compared to other crops. At a yield level of 40 bushels per acre, the harvested seed is estimated to contain at least 150 lbs. of nitrogen, 35 lbs. of phosphate, 55 lbs. of potassium, and 7 lbs. of calcium (1).

Crop Rotation

Crop rotations serve two primary purposes: to improve soil fertility and to break pest cycles. With regard to fertility management, rotation strategies concentrate mainly on generating and conserving nitrogen. Nitrogen is commonly the most limiting element in organic production, especially for corn and small grains, which complement soybeans in most crop sequences. Crop rotations that include forage legumes are the key means by which nitrogen is supplied to the system. The most effective of these legumes in most

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U.S. locations is alfalfa, though other legumes are also effective. Well-established alfalfa, left in place for two or more years, can supply a high level of biologically fixed nitrogen for subsequent, non-leguminous crops.

Non-forage legumes, including soybeans, are moderate nitrogen-fixers. However, most of the nitrogen is removed with the harvested portion of the crop, leaving little residual nitrogen for subsequent crops. This is not to downplay soybeans' contribution to nitrogen fertility; the subsequent crop often exhibits some residual benefit. (One traditional rule of thumb suggests that there is a residual nitrogen gain of only 1 lb. nitrogen for each bushel of harvested soybean yield.) The key point of this discussion is that soybeans should not be considered an equal substitute for legume forages in standard rotations.

To get a good idea of how to design crop rotations for optimum fertility and pest management, see the enclosed article "Planning Crop Rotations."

Cover Crops & Green Manures

Growing and incorporating green manures is another means of improving soil fertility for soybeans and other main crops. This traditional practice had fallen out of favor, as farmers felt they could not afford to skip a season of cash cropping for the benefit of soil improvement. The practice has been revived in recent years, however, as interplanting and winter cover-cropping strategies have emerged. These allow the grower to use cover crops with minimal disruption of the cash-crop cycle. For additional information on cover crops, see ATTRA's *Overview of Cover Crops & Green Manures*.

Some cover-cropping schemes use ridge-till and reduced-tillage planting strategies: the winter cover crop is either winter-killed or mechanically killed and the following crop is planted in the residue. For more information on this topic, request ATTRA's *Pursuing Conservation Tillage Systems for Organic Crop Production*.

Livestock Manures

Farms producing livestock and farms that are in proximity to confinement operations have the advantage of access to animal wastes, which contain major nutrients and organic matter. Proper application and soil incorporation of fresh manure ensures the maximum capture and delivery of nitrogen to the crop. That's why manure is often applied prior to corn planting in crop rotations. There are several important considerations in the use of fresh manure. For more information, request the ATTRA publication *Manures for Organic Crop Production*.

Composting is a means of stabilizing and enhancing livestock wastes for storage, in order to avoid certain problems inherent in applying fresh manure. Composts, though lower in total nitrogen, are a more balanced fertilizer and are more useful in building soil fertility over time. For additional information on composting, request ATTRA's *Farm-scale Composting Resource List*. ATTRA also has information on Biodynamic™ composting and Controlled Microbial Composting™.

The Benefits of an Organic System

Crop rotation, cover cropping, green manuring, use of livestock manure, and composting contribute much more to the whole agroecosystem than may be readily apparent. By adding organic matter and stimulating biological activity in the soil, these practices make mineral nutrients more available to plants, generate the microbial production of plant-beneficial chemicals (e.g., streptomycin), and improve the soil's tilth. Spreading livestock manure, in particular, cycles essential macro- and micro-nutrients back onto the fields.

Rock Minerals—Lime

Because manures are imbalanced fertilizers, and because not all soils are equally rich in native fertility, organic farmers often need to import supplementary nutrients to ensure balanced crop nutrition. These inputs are commonly in the form of moderately priced, minimally processed rock powders.

The most commonly used rock powders in organic systems are various agricultural liming materials. By definition, agricultural lime is used to neutralize the acidity of soils and to provide plant nutrients—mostly calcium and magnesium. There is considerable disagreement in agronomic circles as to which liming materials are most appropriate under various circumstances. Of greatest concern is the possible overuse of dolomite or dolomitic lime, which contains high percentages of magnesium relative to calcium. It is believed that soil magnesium buildup has detrimental effects on soil structure, and that soils with excessive magnesium produce nutritionally imbalanced livestock feed.

A common approach to liming—one popular among many organic growers—measures the ratios of positively charged ions in the soil. This is known as the Albrecht or CEC (Cation Exchange Capacity) System. It is based on the philosophy that the primary reason to add lime is to supply essential nutrients and that soil acidity will reach a desired level when all minerals are present in proper balance. Overuse of dolomitic lime is avoided with this approach. The more conventional approach is based largely on supplying lime as a neutralizing agent; nutrient ratios are generally ignored.

Lime and other rock mineral powders should only be applied with the guidance provided by soil testing. To determine what sort of recommendation one will receive from a soil testing laboratory, it is often necessary to ask in advance. A list of laboratories that use the Albrecht System is provided in the ATTRA publication *Alternative Soil Testing Laboratories*.

Rock Minerals—Other Major Sources

When supplementary phosphates are required in an organic system, they are usually supplied as rock phosphate. Rock phosphates are generally classified as one of two types: hard-rock or colloidal soft-rock phosphate. Hard-rock phosphate is available from several geological sources and varies considerably in appearance and soil reactivity. North Carolina Black Rock Phosphate® is one brand that has a reputation for performance in the field and is easy to handle.

Soft-rock or colloidal phosphate is a dried clay-based by-product of hard-rock mining. Although powdery and difficult to handle, it has a good reputation as a phosphate source on a wide range of soils.

Gypsum (calcium sulfate) is often referred to as a liming material because of its calcium content. However, since it does not neutralize soil acidity, this designation is technically incorrect. Gypsum can be used to supply calcium and sulfur. It is especially useful on high-pH and sodic soils, and is reputed to improve soil structure under some conditions.

Supplemental potassium is generally supplied in the form of sulfate of potash-magnesia (e.g., Sul-Po-Mag®) and selected sources of mined potassium sulfate.

There are other rock mineral powders available for agricultural use, including greensand, lava sand, and granite dust. Generally speaking, most are relatively expensive and not economical for agronomic crops.

Unique Soil Products

Several other soil additives are available to organic growers as soil fertility enhancers. These include humates, humic acids, surfactants, bioactivators, Biodynamic™ preparations, and others. These products are often expensive and performance can be highly specific to circumstances. ATTRA has additional information on several products including humic materials and Biodynamic™ preparations. Also available on request are the ATTRA publications *Alternative Soil Amendments* and *Sources for Organic Fertilizers & Amendments*.

Foliar Fertilization

Crop nutrition can also be supplemented via foliar feeding. There are several organically approved fertilizers and materials that can be used. Request the ATTRA publication *Foliar Fertilization* for more information.

Weed, Insect, and Disease Pest Management

Reasonable control of weeds must be maintained to ensure profitable soybean yields. Considerable guidance on non-chemical weed control can be found in the ATTRA publication *Principles of Sustainable Weed Management*, available on request. Fortunately, a good crop rotation along with proper fertility management appears to suppress most soybean pest problems in organic production.

Where nematodes have become a problem, rotating to non-host crops and integrating nematicidal cover crops into the crop mix have proved effective. For more detail, see ATTRA's *Alternative Nematode Control* publication. Leaf- and pod-feeding caterpillars are readily controlled by well-timed applications of *Bacillus thuringiensis*. Various formulations are currently available, often through conventional sources. White mold, which has become a serious problem in conventional production, has a number of management options. See ATTRA's *Organic Control of White Mold on Soybeans* publication. For more information on pest control strategies without conventional pesticides, refer to ATTRA's *Biointensive Integrated Pest Management* and *Farmscaping to Enhance Biological Control* publications.

Economic and Marketing Considerations

Limited information has been developed on the economics of organic crop production. The enclosed budget information from Rutgers University is intended for the northeastern U.S. but should serve as a starting point in determining production costs elsewhere. Remember to consider organic production economics in light of a whole-farm crop mix, dictated in significant part by rotation requirements. To assist in planning, the enclosed budgetary information also includes information on organic corn and alfalfa production—crops commonly rotated with soybeans in many production regions.

When estimating crop yields under organic management, many factors need to be considered, such as the current fertility status of the soil, whether or not manure resources are available, and the stability of the whole-farm ecosystem as it relates to natural biological pest control. The process of conversion to certified organic farming can be challenging and disconcerting.

In post-transition organic systems, experience has indicated that organic soybean yields are usually comparable to those obtained under conventional management. Legume hay yields might also be comparable to conventional yields, though less information exists to confirm this. Corn and small-grain yields are generally somewhat lower due to limited nitrogen availability. Often, however, organic production costs are lower and cancel out lost revenues due to yield reduction, even when organic crops are marketed through conventional channels.

Market premiums are a significant motivating factor for transitioning to organic production. In recent years, the market for organic soybeans has appeared especially attractive (note the enclosed articles "Go Organic?" and "Organic Farmer Taps…"). Farm gate prices for cleaned 'Vinton' organic soybeans ranged from $17 to $20 per bushel during most of the first quarter of 2002. During that same period, clear-hilum soybean prices ranged from $11 to $14 (2).

Frequently, the organic market specifies 'Vinton' and other varieties of food-grade soybeans. These varieties are used primarily in the production of tempeh, tofu, soya nuts, and a host of other products and are generally grown under contract. For more details, ask for ATTRA's *Marketing Organic Grains*, *Soyfoods: Adding Value to Soybeans*, and *Edible Soybean Production and Marketing* publications.

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