NCAT's
Organic Crops Workbook
A Guide to Sustainable and Allowed Practices

NCAT's Organic Crops Workbook is designed for use by organic and transitional producers with cropping or mixed crop and livestock operations. Producers having certified or transitional livestock enterprises should also utilize *NCAT's Organic Livestock Workbook*.[1] This workbook series is intended to be consistent with the requirements of the National Organic Standard.

Lettuce crop in Central California
photo by Gary Kramer 2001
USDA Natural Resources Conservation Services

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NCAT

Contents

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So, here's the scoop…

The Purpose and Use of This Workbook

One of the greatest challenges to organic farming today is understanding and navigating the Organic Regulations. This workbook[3] is designed to help you in this regard. It addresses, among other things, the wide range of practices and materials allowed under the National Organic Standard. Particular emphasis is placed on farming strategies and practices that promote sustainability.[4] This workbook will be especially useful to growers contemplating conversion to organic production, and to those who are in the early years of transition. If you are a beginning farmer, or are contemplating conversion to organic farming, we encourage you to read this workbook before completing your application for certification. Please note that this is NOT a required document; it is a helpful guide that you may use as you wish. Hint: Your certifier would love to know you are using this workbook for guidance; consider showing it to your inspector.[5]

And speaking of organic inspectors, as you will learn in this workbook, organic inspection is an annual process. The individual who conducts the inspection—the organic inspector—represents the certifying agent. It is the inspector's responsibility to look for documentation and indicators that bear out the producer's claim to organic status, as well as to look for any violations. To succeed at their job, organic inspectors are trained to look critically at all aspects of an organic operation; few details escape their notice. This workbook presents an inspector's perspective and attempts to address all of the different areas that inspectors investigate while visiting a farm operation.

Much of the useful information in the workbook is presented as brief discussions. Numerous endnotes are provided; most of these suggest further sources of information. You will also find a number of questions at the end of each section, which serve as a checklist for sustainable practices and for preserving organic integrity. There are a number of questions that draw particular attention to areas that may affect eligibility for certification. In most instances the pertinent section and paragraph of the Organic Regulations will be shown in brackets, for example, [§205.203(c)].

Consider each of the questions carefully and place a check in the appropriate "Yes," "No," or "Not Applicable" (n/a) box. Providing answers that accurately reflect your current circumstances will be the most helpful to you—honesty will be your best policy. Ideally, you will have most of your checks in the "Yes" boxes.

If you want to make optimum use of this workbook as a guide to information sources, try using the electronic versions (.html and .pdf) of the workbook that can be found on the ATTRA website at <http://www.attra.ncat.org>. The workbook is featured under the section on organic farming. The publications referenced in the endnotes are mostly free-of-charge resources accessible on the World Wide Web, and are active hypertext links. Clicking on any of these links will "jump" you immediately to that resource. But be aware, electronic addresses can change. If a link does not work for you, submit your request to the appropriate entity—State Cooperative Extension Office, ATTRA, or other. A contact list for the primary information providers and Extension Publication Offices can be found toward the end of the workbook.

Please note that some resources listed in the endnotes may not be fully consistent with the National Organic Standard. For example, Cooperative Extension Publications on organically acceptable pesticides often include nicotine, which is now specifically prohibited. When you have a question about whether any practice or product is allowed in organic production, CONSULT YOUR CERTIFIER. This is advice we will give frequently throughout this workbook.

I. Organic Agriculture in America

There are many notions of what organic agriculture is. In 1995, the National Organic Standards Board defined it as "an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony."

The legal definition, provided in the National Organic Program Regulations, states that "Organic production [is] a production system that…respond[s] to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biological diversity" [§205.2]. While these definitions are helpful, they have more meaning when one considers them in light of how organic farming and the organic marketplace evolved.

Contemporary American organic farming has its roots in the humus[6] farming movements that proliferated in Great Britain and Continental Europe from the 1920s through the 1950s. These movements evolved largely in response to the increasing use of synthetic fertilizers. The proponents of humus farming believed that the highest quality food and the sustainability of agriculture were achieved through systems and techniques that built and enhanced the living organic or humus complex of the soil. Humus farming was typified by mixed farms that had both livestock and crop enterprises; they featured cropping schemes that included both food and feed crops, plus legume and grass forages, and green manure crops. Humus farming made little or no use of soluble commercial fertilizers or pesticides, in good part because they were not needed and could even be counterproductive in systems so-modeled on nature.[7]

The 1960s and 1970s brought more visibility to organic farming as public concern over pesticide use increased. The non-use of pesticides eventually became a major focus of organic agriculture as demand for organic products grew, creating an industry out of a practical philosophic movement. Organic industry growth led to the establishment of standards and third-party certification to ensure consistency and enhance credibility.

As the industry expanded during the 1980s, disparities among certifier standards, barriers to trade, and incidents of fraudulent marketing led many to believe that more regulation was needed. Finally, in 1990, Congress passed the Organic Foods Production Act (OFPA).[8] The OFPA mandated creation of the National Organic Program (NOP) and an advisory body, the National Organic Standards Board (NOSB). The OFPA paved the way for creating a single set of US standards for organic production, labeling, and marketing, which now exists in the form of the National Organic Program Regulations, a.k.a. the National Organic Standard.[9] Many other countries, such as the European Union and Japan, have their own organic standards for products produced in or imported into their countries. US organic producers planning to export their products must take these standards into account when certifying their operations.

II. Certification

Certification under the National Organic Program is the license to label, represent, and market your products as organic. Producers obtain certification from state or private certifiers that are accredited through the National Organic Program and who act as its licensing agents. [10]

Under the NOP Regulations, all operations or portions of operations that produce or handle agricultural products that are intended to be sold, labeled, or represented as organic must be certified. Noncertified producers who represent themselves or their products as organic risk prosecution and fines.

A three-year conversion period is required to achieve full organic status. In other words, no prohibited substances may be applied to the land for 36 months prior to the harvest of any product that will be labeled or otherwise represented as organic [§205.202(b)].

If you are purchasing or renting land that is not currently certified and you wish to document that it has not had prohibited substances applied, you must obtain verification from the previous landowner or manager.[11]

Annual inspections are part of the certification process. The inspector is an agent of the certifier. It is the inspector's responsibility to look for documentation and indicators that bear out the producer's claim to organic status, as well as to look for any violations. You must allow the inspector complete access to your operation, including all production facilities and offices [§205.400(c)]. Additional inspections may be announced or unannounced at the discretion of the certifier or the state organic program [§205.403(a)(2)(iii)].

Once certification has been granted, it is granted in perpetuity unless surrendered, suspended, or revoked. For certification to continue, annual certification fees must be paid, the Organic System Plan (see Section III of this workbook) must be updated yearly, and previous non-compliances must be addressed [§205.406].

Any action to suspend or revoke certification must be handled in the manner prescribed in the Standard in §205.660–§205.664. If the status of your certification is threatened and you wish to dispute it, the process for seeking mediation is specifically covered under §205.663. Further details of these provisions will not be addressed in this workbook, but you should be aware that a formal grievance process exists.

Producers who market less than $5000 of organic products annually are not required to apply for organic certification. They must, however, comply with the organic production and handling requirements of the National Standard. The products from such non-certified operations cannot be used as organic ingredients in processed products produced by another operation; such non-certified products are also precluded from displaying the USDA organic seal.

It is important to recognize that organic certification addresses the ***process*** involved in producing and handling a product. Organic certification assures the consumer that the product was grown using organic methods, that synthetic pesticides, fertilizers, and genetically engineered organisms were not used in production, and that precautions were taken to prevent contamination from the outside. It does not guarantee that the product is completely free of all pesticide residues or GMO contamination. (The vast proliferation of pesticides and GE crops precludes virtually everyone from making such a claim.) Organic certification also does not ensure that the products are nutritionally superior.[12] However, organic farmers and consumers firmly believe that organic food and feed is healthier, and that organic production is better for the environment.

2.1	***Do you have a copy of the National Organic Standard[13] and/or the standards of your certifying agency readily accessible as hardcopy or "bookmarked" on your web browser?***	☐ Yes ☐ No ☐ n/a
2.2	***Is/Are your certifier(s) accredited by the National Organic Program?***	☐ Yes ☐ No ☐ n/a
2.3	***Did you advise your certifier(s) of any previous applications for certification, including the names of the certifiers, dates of application, and the outcomes of those applications [§205.401(c)]?***	☐ Yes ☐ No ☐ n/a
2.4	***If you are updating your certification, have you addressed any and all non-compliance issues and conditions previously noted by the certifying body [§205.401(c)]?***	☐ Yes ☐ No ☐ n/a
2.5	***Have you discussed any previous suspensions or denials of organic certification with your certifier [§205.401(c)]?***	☐ Yes ☐ No ☐ n/a
2.6	***If you are now selling crops as organic, do they all come from land which has been free of prohibited substances for a minimum of 36 months prior to harvest [§205.202(b)]?***	☐ Yes ☐ No ☐ n/a

Notes on Certification

III. Organic System Plan

In comparison to many of the industry standards that preceded it, the National Organic Standard is much less prescriptive—that is, it tends to characterize in general terms what an organic operation should be like and leaves the details for producers and certifiers to work out. The principal tool for working out such details is the Organic System Plan.

Under the National Organic Standard, each certified organic farm or ranch must have an *Organic System Plan (OSP)*, also referred to as the *organic farm systems management plan* or the *organic production and handling system plan*. The OSP is a detailed outline that explains how you intend to operate your farm or ranch to satisfy the requirements of the NOP Regulations. According to §205.201(a) of the National Standard, the OSP must contain:

- a description of farm practices and procedures to be performed and maintained, including the frequency with which they will be performed;
- a list of each substance to be used as a production or handling input, indicating its composition, source, location(s) where it will be used, and documentation of commercial availability, as applicable;
- a description of the monitoring practices and procedures to be performed and maintained, including the frequency with which they will be performed, to verify that the plan is effectively implemented;
- a description of the record keeping system implemented to comply with the require ments established in §205.103 (see Text Box 3A in this section of the workbook);
- a description of the management practices and physical barriers established to prevent commingling of organic and conventional products on a split operation, and to prevent contamination with prohibited substances of organic products as well as the production and handling operations (see Text Box 3B in this section of the workbook); and
- additional information deemed necessary by the certifying agent to evaluate compliance with the regulations.

Text Box 3A

Requirements for Recordkeeping

§205.103 deals with the requirements for recordkeeping by certified operators. The records must:

1) be well-adapted to the business being conducted,
2) disclose all activities and transactions in adequate detail,
3) be maintained for not less than five years beyond their creation, and
4) be sufficient to demonstrate compliance with federal regulations

Your records must also be available for inspection and copying during normal business hours by authorized representatives of the Secretary of Agriculture, the State Organic Program, and/or the certifying agent [§205.103(c)].

The OSP must be written by the producer and agreed to by the certifier. It must reflect all current production methods and all materials that will be used. Producers should use the OSP to explain and rationalize practices they feel they need to manage effectively—especially those which may not have clear acceptance in the National Standard. For example, some organic growers feel that tomatoes grow better in continuous culture, that is, not rotated with other crops, if compost is made from the tomato crop residues and returned to the field. Such producers can use the OSP to make their case, explaining the practices they will employ and how the system will be monitored to assure that it is working. The certifier can then decide whether such an alternative still complies with the Federal Standard.

The OSP should also address future intentions and improvements. The OSP can be a vital tool for good organic management while assuring compliance with the National Standard.

Should you need to deviate from the OSP that you have agreed upon with your certifier, it is imperative that the certifier be advised [§205.406(a)(1)(i)]. It is required that you consult your certifier about planned changes in advance [§205.406(a)(1)(ii)]. An annual update of the plan is a requirement for continuation of certification [§205.406(a)(1)].

It is standard practice for the OSP to be incorporated in the *application for certification*, which is required by certifiers at the outset. In other words, you are completing your OSP at the same time you are filling out your application for certification. In such instances, a separate System Plan document is not required. There may also be some instances in which plans submitted to qualify for federal aid or assistance programs may satisfy the requirement for an Organic System Plan [§205.201(b)].[14]

An accurate map of all farm acreage and production units is typically required as part of the OSP.[15] Important map features include:

- consistent scale (Farm Service Agency photo maps may be used)
- permanent field numbers or names (production bed numbers for intensive operations)
- permanent greenhouse unit numbers
- buildings, roadways, and similar features
- hydrologic features: wells, rivers, ponds, irrigation ditches, springs, major drainages, waterways
- field boundaries and adjoining land use; that is, conventionally farmed, fallow, certified organic, etc.
- buffer zones
- contiguous non-crop areas under your ownership or management (for example, wildlife habitat, woodlot, range)

Text Box 3B

Coming to Terms

Contamination can be defined as contact or pollution with a prohibited substance; for example, conventional pesticides, GMO pollen.

Commingling is the physical contact and possible mixing of an organic product with a similar conventional product.

Transitional land is acreage that has been managed organically for less than 36 months Because the term "transitional" does not have legal status in the National Organic Standard, crops harvested from transitional land may not be sold, labeled, or represented as "transitional." The status of such crops is, for all intents and purposes, conventional.

Split production farms are those that produce both organic and nonorganic products (nonorganic includes transitional products).

Parallel production is essentially a subset of split production. The term is used to describe a situation where the same crop (and often the same crop variety) is produced both organically and nonorganically on the same farm operation.

Field histories are also required as part of the OSP. Field histories should document:

- field size (you may use square footage for greenhouse / production beds)
- crops / cover crops for current and previous years (three-year minimum)
- all inputs used for current and previous years (three-year minimum)
- field status (Organic, Transitional, Conventional) for previous years (three-year minimum)

One of the realities of organic farming under the Federal Standard is the expected increase in operations that feature both organic and conventional production. The terms *split* and *parallel* are commonly used to describe such farms (see Text Box 3B in this section of the workbook). Many certifiers require that field

histories and other records cover conventional as well as organic management on split and parallel operations. It is important that the OSP addresses all hazards of contamination and commingling that may arise. Prior to the development of the National Organic Program Standard, a number of certifiers required that split operations have a long-term plan for full conversion to organic. There is no such requirement in the National Organic Program Regulations.

☐ Yes ☐ No ☐ n/a 3.1 ***Have you completed your Organic System Plan (OSP) [§205.201(a)]?***

☐ Yes ☐ No ☐ n/a 3.2 ***Has your OSP been approved by your certifying agent(s) [§205.201(a)]?***

☐ Yes ☐ No ☐ n/a 3.3 ***Is your farm map complete and accurate?***

☐ Yes ☐ No ☐ n/a 3.4 ***Have you completed a field history sheet?***

☐ Yes ☐ No ☐ n/a 3.5 ***Are the numbers/names used on your map consistent with those used on field histories, audit documents, and other records?***

Notes on Organic System Plan

IV. Adjoining Land Use

Organic crops must be protected from contamination by prohibited substances used on adjoining lands (for example, drifting pesticides, fertilizer-laden runoff water, and pollen drift from genetically engineered crops—see Text Box 4A in this section of the workbook). Contamination prevention for organic systems usually requires a multi-pronged approach. Strategies may include one or more of the following:

- isolation—Fields and farms that are remote or are located at substantial distances from conventional production, roadside spraying, or industrial uses are considered to be adequately protected.
- barriers—Hedges and woods serve as barriers to air- and water-borne contaminants.
- buffer zones—It is common practice for farmers to designate a buffer zone along borders where adjoining crops are conventionally managed. Crops harvested from buffer zones may not be sold as organic but may be sold into the conventional market.

- drainage diversion
- posting of property (for example, signage reading "Organic Farm: Do Not Spray," etc.)[16]
- formal notification—Written notification is provided to neighbors, utilities, and authorities that manage adjoining lands and rights-of-way requesting cooperation to reduce contamination. You may need to assume responsibility for weed control on roadsides and rights-of-way as part of any resulting agreement. Copies of formal notification letters must be kept on file.[17]
- verification of adjoining land use—A signed statement by the owner or manager of adjoining land serves as acceptable documentation.[18]

The use of buffer zones has a long history in certified organic production. Traditionally, such buffers were defined by width only, with 25 feet being the common distance specified in most certifier standards. The National Organic Program Standard does not specify the required width for a buffer zone, it speaks only to the need to minimize contamination. Therefore, the width (and height, in some instances) of buffers may need to be adjusted for individual circumstances—for example, a more significant buffer is needed where adjacent land is sprayed by plane or helicopter.

If your certifier suspects product contamination, residue testing may be required. If residue levels exceed 5% of the EPA tolerance levels, the product may not be sold, labeled, or represented as organic [§205.671]. Note that residue testing is not an accepted substitute for buffer zones or other strategies to prevent contamination. It can, however, serve as an indicator that those strategies are effective.

Text Box 4A

Genetic Engineering (GE) and Genetically Modified Organisms (GMOs)

Genetic engineering is considered an *excluded method* in the National Organic Program Regulations. §205.2 defines *excluded methods* as

> a variety of methods used to genetically modify organisms or influence their growth and development by means that are not possible under natural conditions or processes and are not considered compatible with organic production. Such methods include cell fusion, microencapsulation and macroencapsulation, and recombinant DNA technology (including gene deletion, gene doubling, introducing a foreign gene, and changing the positions of genes when achieved by recombinant DNA technology). Such methods do not include the use of traditional breeding, conjugation, fermentation, hybridization, in vitro fertilization, or tissue culture.

Genetically engineered crops are a new feature of the agricultural landscape, and the organic community is still coming to grips with it. At the present time, detectable residues of GMO contamination might not be considered a violation of organic regulations, however, detectable GMO residues may preclude sales to foreign buyers. Producers may not use GMOs in organic production and must take steps to prevent contamination. Guidelines for preventing genetic drift from GM crops to organic fields are being evaluated.

There is no established tolerance or threshold level for GMO contamination in the Organic Standard as yet. However, many buyers set their own tolerance levels. This is especially true for product sales to the European Union and Japan.

4.1 ***Are all fields well-isolated or provided with buffers to prevent contamination [§205.202(c)]?*** ☐ Yes ☐ No ☐ n/a

☐ Yes ☐ No ☐ n/a 4.2 ***If there is danger of contamination from adjoining land, are you taking steps to minimize the risk [§205.202(c)]?***

☐ Yes ☐ No ☐ n/a 4.3 ***Have you notified your certifier(s) of any drift or misapplications of prohibited substances to any field, production unit, site, facility, livestock, or product that is part of the organic operation [§205.400(f)(1)]?*** If serious drift occurs, you should also contact your State Department of Agriculture, which has (or should have) the responsibility to follow up on such matters.[19]

☐ Yes ☐ No ☐ n/a 4.4 ***Have you consulted your certifier to learn if they have specific requirements for buffer zones or other matters relating to adjoining land use?***

Notes on Adjoining Land Use

V. Supporting Biodiversity and the Rotation Practice Standard

The National Organic Standard defines organic production as a production system that "respond[s] to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity" [§205.2]. Aside from an additional mention of "biological diversity" in the definition of crop rotation, the practice standards do little to highlight biodiversity as something to be measured and monitored.

Biodiversity is a principle of sustainable agriculture and an important indicator of a healthy organic farm or ranch.[20] It plays a particularly crucial role in pest management. Diverse agricultural systems support strong populations of predators and parasites that keep pest populations at manageable levels. Organic producers support biodiversity in their operations through a host of means, including:

- rotation[21] of crops in annual cropping systems—Crop rotation refers to the sequencing of crops over time on a field or planting bed. Rotations can be chosen to break insect pest and disease life cycles. By altering the nature and timing of cultural practices, rotations also suppress many weeds. Legumes in rotation build nitrogen reserves for subsequent crops; sod-forming crops in rotation build organic matter. The longer and more diverse a crop rotation, the more these benefits are achieved.
- use of cover crops[22] within crop rotations—Cover crops are crops or crop mixtures grown between perennial trees / vines / bushes, between crop rows, or on fields between cropping seasons to build soil fertility, to protect against erosion, to suppress weeds, and to provide habitat for beneficial organisms.
- minimizing soil disturbance to encourage earthworms and soil organism diversity
- limiting the use of botanicals and other natural-but-broad-spectrum pesticides
- introducing beneficial organisms in the form of soil or compost inoculants, as beneficial predators and parasites, or as pollinators
- maintenance of cover crop or natural vegetation in perennial fruit and nut plantings
- intercropping[23] and companion planting[24] in vegetable and grain crops
- using mixed forages (grasses, legumes, forbs) in hay and pasture production
- agroforestry[25]—Agroforestry is the combining of long-term perennial tree crops with other enterprises such as pasture, small fruit production, grain crops, etc.
- establishing habitats for beneficial insects and wildlife[26]
- adjusting timing and reducing the frequency of mowing on non-crop lands to accommodate nesting birds and other wildlife
- providing roosting, nesting, or sheltering structures such as bird or bat houses
- using more than one cultivar or variety for each crop being grown
- diversification of farm enterprises
- introduction and integration of livestock enterprises—Organic farms are NOT required to have livestock or to use livestock manures in order to be certified organic. However, integrating livestock with crops is a sound step towards making the whole farm operation more diversified and sustainable.[27]

Crop rotation is one tool of diversification that is specifically required in the National Standard [§205.205]. The requirement for crop rotation applies to annual cropping systems. As the Regulations state in §205.2, "Perennial cropping systems employ means such as alley cropping, intercropping, and hedgerows to introduce biological diversity in lieu of crop rotation."

Farmers are required to implement a crop rotation that maintains or builds soil organic matter, works to control pests, manages and conserves nutrients, and protects against erosion [§205.205]. The diversity (crop mix) of a rotation and the length of the rotation cycle are dependent on a number of factors, including market, climate, and soil fertility. However, the following characteristics are generally typical of successful organic crop rotations:

- a crop sequence that features soil improving crops (sod crops, green manures, etc.) to counterbalance soil depleting crops (row crops)—Sod-forming crops are forage crops dominated by perennial grasses and perennial legumes. Sod crops in rotation build soil organic matter and reverse the decline that typically occurs when cultivated annual crops—especially row crops like corn, soybeans, vegetables, or cotton—are grown. For a sustainable system, it is ideal to have at least one year of sod crop for every year of row crop in a rotation cycle.
- the inclusion of leguminous crops and cover crops (for example, alfalfa, clovers, beans, peas, vetch, lespedeza, etc.), which fix nitrogen from the atmosphere (see Text Box 5A in this section of the workbook)

- the sequencing of crops to suppress insect pests and diseases—For example, in order to avoid black rot and black leg infection, the various species within the cabbage family should not follow each other in a cropping sequence. In another example, corn is alternated with soybeans or forage crops to break the life cycles of Northern and Western corn rootworm beetles. However, nature does not take kindly to those who "cut corners." Many Midwestern corn producers adopted the shortest rotation possible—corn-soybeans-corn-soybeans—only to find that, by the mid-1990s, both species of rootworm had evolved means of survival. History has shown that the longer and more diverse crop rotations practiced by organic farmers are much more effective at suppressing insect and disease pests.
- the sequencing of crops for weed management—The variation in cultural practices plays a key role. For example, weed control in both potatoes and squash is relatively easy. Therefore, these are referred to as "cleaning" crops. It is a good strategy to plant poor weed competitors, such as carrots and radishes, after potatoes and squash in a rotation.[28]
- a mix of crops and cultural practices that minimizes the duration of time that soil is bare
- the scheduling of cover crops whenever possible to:
    - protect the soil from erosion
    - prevent leaching of crop nutrients
    - supplement nitrogen fixation
    - build organic matter
    - smother weeds
    - suppress soil pests and diseases

Text Box 5A

Nitrogen in Organic Systems

Nitrogen is the limiting nutrient on most organic farms. The most economical source of nitrogen is from legumes. Biological nitrogen fixation in legumes results from a symbiotic relationship between the plant and rhizobium bacteria. Rhizobium bacteria "infect" the roots of legumes, forming nodules. The bacteria then fix nitrogen from the air as proteins, which are shared with the legume host and adjacent plants. Forage legumes in particular fix so much nitrogen that there is an abundance available for subsequent non-leguminous crops.

The inoculation of legume seed may be necessary to optimize nitrogen fixation. If you have observed good nodulation on the same legume crop in the last three to five years, re-inoculation may not be necessary. If inoculation is required, rhizobium inoculant can be purchased for this purpose. Be certain you are requesting an inoculant appropriate to the kind of legume you are planting. Also, be certain that you specify a rhizobium product that does not contain genetically engineered material.

Organic farmers are encouraged to rely as much as possible on "home-grown" nitrogen; that is, nitrogen from legume crops and cover crops, and that recycled by their own livestock manure. Not only is this more sustainable, it reduces the problem of soil nutrient overloading that frequently occurs when farms import and apply large quantities of manure over many years.

☐ Yes ☐ No ☐ n/a 5.1 ***Have you implemented a crop rotation that works to maintain or build soil organic matter, control pests, manage and conserve nutrients, and protect against erosion [§205.205]?***

☐ Yes ☐ No ☐ n/a 5.2 ***Are you using cover crops to support beneficial insects and wildlife, as well as to protect and build the soil resource?***

5.3 ***Are you providing non-crop areas as habitat for beneficial insects and wildlife?*** ☐ Yes ☐ No ☐ n/a

5.4 ***Have you considered adding more enterprises to your operation?*** ☐ Yes ☐ No ☐ n/a

Notes on Biodiversity and Crop Rotation

VI. Organic Soil Management

The discussion provided here is brief and does not make clear how fundamentally important soil management is to a working organic system. There are many excellent books on the subject, but to get a good perspective, see ATTRA's Sustainable Soil Management at <*http://attra.ncat.org/atra-pub/soilmgmt.html*> *and the University of California's* Soil Management and Soil Quality for Organic Crops *at* <*http://anrcatalog.ucdavis.edu/pdf/7248.pdf*> *and* Soil Fertility Management for Organic Crops at <*http://anrcatalog.ucdavis.edu/pdf/7249.pdf*>.

Organic agriculture is built around the notion that providing nutritious food and feed is the best way to improve and sustain the health of people and livestock, and that the best way to grow nutritious food is by emulating nature, which begins with feeding the organisms of the soil. Soil micro- and macro-organisms are the external digestive system that processes organic matter, delivering a smorgasbord of minerals, vitamins, and other nutrients to the crop at a metered pace. This is in contrast to the conventional approach where crops are flooded with a limited number of soluble fertilizer nutrients, leading to "luxury consumption," imbalanced plant nutrition, and a susceptibility to disease and attack by insect pests.

The food that soil organisms need to do their job comes in the form of organic matter, thus composting, manuring, extended crop rotations that include sod crops, green manuring, and similar activities are the standard practices of organic farming.

For the producers of field-scale annual crops, a cropping sequence that includes sod-forming crops is of great value. Sod-forming crops are typically perennial and biennial forage grasses and legumes. Legumes play a special role due to their ability to fix nitrogen (see Text Box 5A in Section V of this workbook). Additionally, cover crops of annual grasses, small grains, legumes, and other useful plants like buckwheat are inserted into the cropping sequence wherever possible to serve as green manures. Intensive vegetable production systems can rely on green manuring strategies as an alternative to multi-season sod forming crops.

Recycling livestock manures onto the land is a common organic practice. It works to close the cycle of nutrient flows on mixed crop and livestock farms, keeping the purchase of additional fertilizers and soil amendments at a low level. Farms without livestock often buy manure or compost, considering them to be among the best fertilizers available, though sole reliance on imported fertilizers can have its drawbacks (see Text Box 5A in Section V of this workbook).

Careful conservation and management of crop residues is part of organic soil management. There is a reluctance to sell too much residue from the farm, since it plays a valuable role in improving and protecting the soil. §205.203(e)(3) of the Organic Regulations also precludes the burning of crop residues except as a means of suppressing diseases or stimulating seed germination.

§205.203 of the National Standard requires that soil loss be minimized. Organic farmers have long recognized the value of basic soil conservation—it makes no sense to build a fertile soil resource just to let it wash or blow away. Generally speaking, organically managed farms have less soil erosion because they manage crop residues carefully, use cover crops, and have a higher proportion of cropland in forages and small grains, as opposed to row crops. Also, the higher organic content of well-managed organic soils holds more water and is more resistant to erosion. In addition, good organic farmers use conventional conservation structures, such as terraces, grass waterways, contours, etc., where necessary. Organic farmers are also inclined to use conservation tillage methods that minimize bare soil.

Organic growers have also learned the value of providing additional mineral nutrition—commonly in the form of lime and other rock powders—where nutrient deficiencies are not fully addressed by humus building practices.

Text Box 6A

Choosing Sustainable Soil Management Practices

Generally speaking, sustainable soil management practices are those that conserve and make the best use of on-farm resources (including solar energy), and minimize reliance on off-farm inputs. Sustainable practices include:

- well-designed crop rotations
- optimum use of cover crops and green manures
- composting or otherwise recycling on-farm manures and other wastes
- good crop residue management
- soil and water conservation practices

Green manuring deserves additional comment. Green manures are crops grown specifically for soil improvement. They are typically plowed, disced, or otherwise incorporated into the soil when they have produced a large amount of biomass, or fixed a significant amount of nitrogen in the case of legumes. Green manuring is an old practice. There is an art and a science to managing green manure crops to meet different objectives; that is, building humus vs. providing the maximum amount of nitrogen to the following crop.

Importing and applying animal manures, composts, rock powders, and other allowed fertilizers is agronomically sound, permitted in organic production, and necessary in most organic systems—especially those in early transition—as long as no pollution or contamination occurs. The long term objective, however, should be to shift reliance to more sustainable practices as the farm matures.

While many farm and ranch operations will require some purchased organic fertilizers and amendments—especially during transition—well-designed organic systems become progressively more self-reliant and require fewer off-farm inputs as they mature. Organic producers should avoid an "input substitution" mentality.

The National Organic Standard requires that farmers "maintain or improve the physical, chemical, and biological condition of the soil and minimize erosion" [§205.203]. Certifiers will expect you to demonstrate that your system is achieving these goals. Soil testing is one of the most common means of monitoring and demonstrating that the soil is not being depleted. The organic community is divided as to what constitutes a good soil test and good soil test recommendations. There is general consensus that, at the very least, the primary nutrients phosphorus and potash, pH, and organic matter should be monitored. However, alternative testing and monitoring procedures might also be allowed and even welcomed.

6.1 ***Have you taken the time to learn about your soil resource?*** Do you know its classification(s)? Erodability potential? Have you studied NRCS soil maps?

☐ Yes ☐ No ☐ n/a

6.2 ***Do you test your cropping soils on a regular basis?***[30] Note: Plant tissue tests and other forms of nutrient monitoring may also be desirable, especially for high value crops; however, these are not generally required for certification.

☐ Yes ☐ No ☐ n/a

6.3 ***Do you keep your current and past soil test results on file as a means of monitoring the effects of your farming practices?***

☐ Yes ☐ No ☐ n/a

6.4 ***Do you make fertility management decisions based on soil test, tissue test, or other nutrient test results?*** Note: Application of concentrated micronutrients (for example, sulfates, chelates, etc.) may be made only if need is documented [§205.601(j)(6)]. This restriction does not apply to materials that are naturally rich in a spectrum of micronutrients (for example, kelp meal, most rock powders, etc.), though soil testing is still advisable in guiding their use.

☐ Yes ☐ No ☐ n/a

6.5 ***Are your crops free of apparent nutrient deficiencies and imbalances?***

☐ Yes ☐ No ☐ n/a

6.6 ***Are you using approved cultural practices and materials to maintain or improve soil humus***[31] ***content [§205.205(a) and §205.203]?*** Allowed practices and materials typically include but are not limited to the following:

☐ Yes ☐ No ☐ n/a

- crop rotation to include sod-forming crops (see Section V of this workbook)
- crop residue management
- conservation tillage[32]
- green manures[33] (see Text Box 6A in this section of the work book)
- composts[34] (see Section XI of this workbook)
- animal manures[35] (see Section X of this workbook)
- fallowing, to allow soil to recover from intensive cultivation
- rotational grazing[36]
- organic materials (leaves, straw, natural fertilizers)
- esoteric practices (see Text Box 6B in this section of the workbook)

Text Box 6B

What Are Esoteric Practices?

Esoteric practices are metaphysical methods for crop management and animal health that are not generally accepted in the conventional scientific community, nor are they easily explained using common scientific terminology. Esoteric practices include homeopathy, radionics, dowsing, the use of biodynamic preparations, astrological planting, and a host of other techniques. Most esoteric practices are allowed in organic production.[37]

☐ Yes ☐ No ☐ n/a

6.7 ***Are you using approved cultural practices and materials to maintain or improve soil mineral levels and crop nutrition [§205.205(c) and §205.203]?*** Allowed practices and materials typically include but are not limited to the following:

- use of catch crops[38]—Catch crops are cover crops—usually grasses—that are grown following heavily fertilized crops to prevent soil nutrients from leaching.
- use of deep-rooted crops and cover crops—Deep, tap-rooted crops such as alfalfa, sweet clover, rape, and mustard are known to extract and use minerals from the deeper layers of soil.
- use of rock minerals and mineral-rich organic fertilizers, manures, and/or composts[39]
- foliar fertilization[40]
- esoteric practices

☐ Yes ☐ No ☐ n/a

6.8 ***Are you using approved cultural practices and materials to supply an adequate level of nitrogen to your crops [§205.205(c) and §205.203]?*** (See Text Box 5A in Section V of the workbook.) Allowed practices and materials typically include but are not limited to the following:

- forage legumes in hay/pasture
- legumes in rotation
- legumes as cover crops, intercrops, or green manures
- rhizobial inoculation of legume seed
- livestock manures or composts
- nitrogen-rich organic fertilizers

☐ Yes ☐ No ☐ n/a

6.9 ***Are you using approved cultural practices and materials to conserve soil and water [§205.205(d) and §205.203]?*** Allowed practices and materials typically include but are not limited to the following:

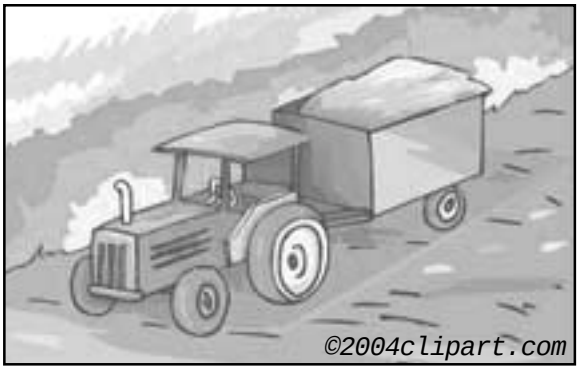
- conservation tillage
- crop residue cover
- cover crops
- strip cropping
- contour cultivation
- applied organic mulches
- fallowing
- windbreaks
- conservation buffers
- other soil conservation structures

6.10 ***Are all the fertilizers and soil amendments you use allowed in organic production [§205.105 and §205.203]?*** Allowed fertilizers and amendments typically include but are not limited to the following:[41] ☐ Yes ☐ No ☐ n/a

- plant materials, extracts, etc.—includes crop residues, leaves, stems, "weed teas", seed meals, wood ash,[42] etc. Residues and extracts of tobacco are prohibited.
- rock dusts—includes most mined minerals, such as aglime, dolomite, gypsum, rock phosphates, granite dust, greensand, natural potassium sulfate, sulfate of potash-magnesia, and glacial gravel dust.
- animal by-products—includes blood meal, bone meal, paunch manure, feather meal
- livestock manures—includes bat and seabird guano
- composts
- marine products and by-products—includes kelp, seaweed extract, fish emulsion, crabshell meal
- microbial inoculants and enzymes—must NOT contain GMO's nor be GMO-derived
- natural soluble fertilizers with restrictions:
  - potassium chloride (muriate of potash)—permitted only if it is derived from a mined source and is applied in a manner that precludes buildup of chlorides in the soil [§205.602(g)]. Note that most commercial sources of potassium chloride are synthetic and NOT allowed in organic production.
  - sodium nitrate (Chilean nitrate)—permitted only if its use constitutes no more than 20% of the crop's total nitrogen requirement [§205.602(h)].

Prohibited fertilizers and amendments include but are not limited to the following:

x synthetic or "artificial" commercial fertilizers, such as anhydrous ammonia, urea, ammonium nitrate, superphosphate, ammoniated phosphates, calcium nitrate, ammonium sulfate, etc.
x biosolids; also known as municipal waste, sewage sludge [§205.105(g)]
x most industrial by-products, especially if contaminated with heavy metals
x ash from manure burning [§205.602(a)]



Text Box 6C

What Can I Use in Organic Crop Production?

One of the greater difficulties that organic producers face on a regular basis is determining whether or not a particular product or material can be used in organic production. Sad to say, the problems real, but some basic clarifications will help. First of all, all natural or nonsynthetic materials can be assumed to be acceptable in organic production. There are a few exceptions, however, which will be explained shortly.

Most organic producers and prospective producers have heard about the *National List*. §§205.600–205.619 of the National Organic Program Regulations comprise the National List; §205.601 and §205.602 are those directly pertinent to crop production. §205.601 includes synthetic materials that are ***allowed*** in organic crop production, for example, sulfur, insecticidal soap, etc.; §205.602 contains natural, or nonsynthetic, materials that are ***prohibited***, for example, ash from manure burning, nicotine sulfate, etc. When considering commercial products, the grower must be aware of all ingredients to determine that none are prohibited. If a full disclosure of ingredients is not found on the label, details should be obtained from the distributor or manufacturer and kept in the grower's files. Note that such details must extend to inert ingredients. When in doubt about the acceptability of any material or product for certified organic production, contact your certifier.

An important organization to know about is the Organic Materials Review Institute (OMRI).[43] OMRI is a non-profit organization that evaluates products for suitability in organic production and processing. OMRI does not have status as a regulatory body. However, its decisions with regard to the acceptability of commercial products is highly respected and accepted by most certifiers. *OMRI Listed* products can be purchased and used with a high degree of confidence. Producers should be aware, however, that there are many acceptable products in the marketplace that have not been evaluated by OMRI and do not carry the *OMRI Listed* seal. Again, it is important to contact your certifier to verify whether a particular product or material can be used.

☐ Yes ☐ No ☐ n / a

6.11 ***If both organic and conventional pastures and crops are fertigated using the same equipment, are you taking steps to ensure that prohibited fertilizer materials do not contaminate organic crops?*** It is a bad idea to irrigate organic crops with the same equipment used for conventional fertigation or for the application of pesticides. However, any certifier that permits dual use will most likely insist on protocols that include thorough cleaning and flushing, plus a date log for all cleanouts and irrigations.

☐ Yes ☐ No ☐ n / a

6.12 ***Do you keep records of all fertilizer and amendment purchases, along with product labels?***

☐ Yes ☐ No ☐ n / a

6.13 ***If you are applying manure, compost, or another acceptable fertilizer or amendment, are you taking care to avoid contamination of surface and groundwater [§205.203(c)]?***[44]

Notes on Organic Soil Management

VII. Weed Management

Weed management[45] is often the greatest challenge to organic crop production, especially for field crops and vegetables. Weeds occur naturally, especially when agricultural soil is left uncovered or the crop is a poor competitor. Building soil fertility using a good humus-building rotation is one of the first steps to effective weed management. A diverse rotation also reduces the number of niches problem weeds can exploit from year to year.

Many difficult-to-control weeds are also indicators that the soil has nutritional or physical problems, and nature is trying to restore health and balance.[46] Avoiding field operations that can damage soil structure is one preventative; careful fertilization is another.

Mechanical controls are commonly relied upon for routine control of weeds, including cultivation, mowing, mulching, and flaming. The timeliness of such operations can make a huge difference in how well they work and how often they need to be performed.

There is a lot of discussion surrounding tillage in organic farming systems. Most organic farmers continue to rely on mechanical tillage to prepare seedbeds and on cultivation to control weeds. Still, there is a strong interest in reducing these activities in order to conserve organic matter, reduce erosion, and save on expenses.

Historically, organic row crop farmers have been pioneers in conservation tillage. Midwestern producers boldly adopted mulch tillage and ridge tillage during the 1970's, while most of their conventional neighbors continued to moldboard plow. Unfortunately, no-till and strip-till technologies have evolved under the influence of herbicides and other conventional chemicals. Adapting these systems to organic production is challenging. Producers are encouraged to explore no-till and strip-till, but to do so cautiously. Keep in mind also, that conservation tillage may not be appropriate for some crops or circumstances. For example, reducing tillage and cultivation can create niches for perennial weeds—like bermuda grass—to thrive. Also, many small-seeded vegetable crops do not do well under reduced tillage systems.[47]

Text Box 7A

Weed and Pest Management Decisions

§205.206—the Crop Pest, Weed, and Disease Management Practice Standard—requires that producers use a three-level hierarchical approach in deciding how to deal with these problems. This can most easily be explained by designating these levels A, B, and C.

Level A: The first line of defense in managing weed, insect, and disease pests generally comprises the most sustainable and systems-based practices. It emphasizes the fact that a well-designed and healthy organic system will naturally have fewer pest problems.
Level A practices specifically include:

- crop rotation and nutrient management [§205.206(a)(1)]
- sanitation measures to remove disease vectors, weed seeds, etc. [§205.206(a)(2)]
- cultural practices such as resistant or tolerant varieties, timing of planting, etc. [§205.206(a)(3)]

Level B: Level B is the second line of defense, to be chosen if the basic systemic practices of level A are not sufficient to control the weed, insect, or disease problem. Level B practices generally include mechanical and physical practices that are traditional in organics, and the use of nonsynthetic or "natural" materials.

Level B weed control options include:

- mulching with fully biodegradable materials [§205.206(c)(1)]
- mowing [§205.206(c)(2)]
- grazing [§205.206(c)(3)]
- cultivation and hand weeding [§205.206(c)(4)]
- flame, heat, or electrical weeding [§205.206(c)(5)]
- plastic mulches [§205.206(c)(6)]

Level B insect / animal pest control options include:

- introducing or augmenting predators and parasites [§205.206(b)(1)]
- developing habitat for beneficial predators and parasites [§205.206(c)(2)]
- nonsynthetic lures, traps, and repellents [§205.206(c)(3)]

Level B crop disease control options include:

- management practices (e.g. fire, flooding) [§205.206(d)(1)]
- application of nonsynthetic biological, botanical, or mineral inputs [§205.206(d)(2)]

Level C: Level C is the third line of defense, to be chosen if the level of pest control required is not achieved after A and B control options are applied [§205.206(e)]. In such instances, you are allowed the wider use of biologicals and botanicals to control pests. You also have the option to use those materials included on the National List under §205.601—"Synthetic substances allowed for use in organic crop production".

If you anticipate the need for level C control measures, be sure that you indicate this in your OSP. Be specific about the control materials you might be using. Outline the indicators or thresholds you monitor that will trigger the use of those materials.

Text Box 7B

Choosing Sustainable Weed Management Practices

The most sustainable weed management practices are usually those that maintain a high degree of diversity in the field, use the least amount of energy and off-farm inputs, and are most cost effective. Some good examples of weed management strategies that enhance diversity include planting nurse crops to aid establishment of forages, intercropping, living mulches,[48] grazing weeds in orchards, and using weeder geese in strawberries and vegetables. Other sustainable strategies include organic mulches, delaying planting to give the crop a competitive start, a crop rotation designed to manage weeds (see example in Section V of this workbook), mechanically killed cover crop mulches,[49] and using higher crop seeding rates to out-compete weeds.

Organic producers make common use of mechanical cultivation, mowing, plastic mulching, and flaming. These traditional methods are allowed in organic production under the National Organic Program Regulations, though they might not be considered sustainable. For many crops and circumstances, these practices are essential and will continue to be in common use until more sustainable alternatives are researched and refined.

Also common in the production of high-value crops is the use of hand weeding. While this is not a polluting or biologically unsustainable practice, it can be costly, mind numbing, and backbreaking—and may have social implications where migrant labor is used. Most organic growers seek to reduce hand weeding in their production systems.

7.1 ***Does your production system keep weeds at manageable levels?*** ☐ Yes ☐ No ☐ n/a

7.2 ***Do you use approved practices or materials to control weeds* [§205.206]?** ☐ Yes ☐ No ☐ n/a

Allowed practices and materials typically include but are not limited to the following:

- crop rotation
- grazing
- smother crops[50]—fast-growing cover crops, like buckwheat, that are used to suppress weeds
- nurse crops—companion crops that are sown with other crops to suppress weeds during establishment years. A common example is the planting of oats to serve as the nurse crop for alfalfa.
- weeder geese[51]
- interseeding
- sanitation—for example, removing weedy stolons and rhizomes from cultivating equipment and cleaning combines of stray weed seed between fields
- competitive crop types and varieties
- higher crop seeding rates
- altered planting schedules—for example, delayed planting by Midwestern organic row crop producers, so that more weeds will germinate, to be killed during seedbed preparation
- natural (nonsynthetic) mulches[52]

- mowing
- cultivation[53]—clean cultivation should NOT be done where or when it will cause significant soil erosion
- hand weeding or hoeing
- solarization[54]—Solarization uses clear plastic to trap the sun's energy and heat the soil to a high temperature. In addition to weeds, this strategy controls many plant diseases and insect pests.
- flooding
- flaming[55] and other forms of thermal weed control
- natural herbicides—for example, vinegar-based (acetic acid) products and myco-herbicides (products such as Dr. Biosedge®, which contains the fungal rust disease organism specific to the yellow nutsedge)
- plastic mulch (see Text Box 7C in this section of the workbook)
- esoteric practices (see Text Box 6B in Section VI of this workbook)

Prohibited materials typically include but are not limited to the following:

- x most synthetic herbicides [§205.105(a)]
- x heavy metal herbicides
- x soap-based herbicides—these may only be used in non-crop areas of an organic farm [§205.601(b)(1)]
- x micronutrient-based herbicides [§205.601(j)(6)

Text Box 7C

Considerations when Mulching with Plastic

Since mulching with non-porous plastic can increase the hazard of soil erosion, appropriate measures must be taken; mulching with plastics must NOT be allowed to cause erosion. Plastic mulches should not be allowed to photodegrade or deteriorate in the field; they may not be disced, plowed, or otherwise incorporated into the soil. In annual production systems, plastic mulch should be removed at the end of the growing season. Plastic wastes should be disposed of in a manner that does not cause pollution or crop contamination. See Text Box 14A in Section XIV of this workbook.

Notes on Weed Management

VIII. Pest and Disease Management

The discussion in this section is cursory. For good general information on organic pest and disease management, see the University of California publications Plant Disease Management for Organic Crops *at* <*http://anrcatalog.ucdavis.edu/pdf/7252.pdf*> *and* Insect Pest Management for Organic Crops *at* <*http://anrcatalog.ucdavis.edu/pdf/7251.pdf*> *and Saskatchewan's publications* Organic Crop Management: Insect Management *at* <*http://www.agr.gov.sk.ca/docs/organics/research/organicinsect.asp?firstPick=Organics&secondPick=Production%20Information&thirdPick=Null*> *and* Organic Crop Management: Disease Management *at:* <*http://www.agr.gov.sk.ca/docs/organics/research/organicdisease.asp?firstPick=Organics&secondPick=Production%20Information&thirdPick=Null*>.

Pests and diseases play a vital role in natural selection by removing sick and unthrifty plants. Organic proponents argue that sickness in plants can be traced largely to poor nutrition and other stresses that result from poor crop and soil management. Organic producers maintain that organic soil-building practices will produce crops that are properly nourished and thereby less susceptible to attack by pests and diseases. Furthermore, organic producers and ecologists agree that natural biological pest control arises in a healthy organic system; this appears in the form of an active complex of natural predators and parasites that suppress pest populations.

In many field crop and vegetable systems, maintaining a biodiverse healthy ecosystem and using well-timed cultural practices are sufficient for pest management; pests may not be eliminated, but damage levels are low enough to be tolerated. This is especially true when organic enterprises are relatively isolated from conventional production. Some crop pests, however, are especially challenging. Examples

Text Box 8A

Inert Ingredients in Organic Pesticides

The Environmental Protection Agency provides four classifications of inert ingredients: List 1, List 2, List 3, and List 4.

- List 1 inerts are those known to be toxic
- List 2 inerts are those that are potentially toxic
- List 3 inerts are of unknown toxicity
- List 4 inerts are of minimal concern

At this time, the National Organic Standard allows the use of List 4 inerts only. Many natural pesticide products routinely used by organic producers prior to the implementation of federal regulation contain List 3 inert ingredients. Unfortunately, since many manufacturers have not yet reformulated their products, it is difficult for producers to know whether a product can or cannot continue to be used for organic production. Products that are *OMRI Listed* contain only List 4 inert ingredients and can be considered safe to purchase and use. Products that are not listed by OMRI and that may contain unspecified inert ingredients should not be used without approval by the certifier or documentation from the manufacturer that the product contains only allowed inert and active ingredients.

include corn earworm on sweet corn[57] and plum curculio on apples east of the Rocky Mountains.[58] In such instances, additional inputs and / or heroic efforts may be needed to obtain a marketable crop. When economic feasibility becomes questionable, the grower should re-evaluate his or her plans to grow the crop.

Producers anticipating the need for natural pesticides have several issues to contend with. The most obvious is to make certain that all materials will be acceptable for organic production. Text Box 6C, in Section VI of this workbook contains information especially pertinent to this topic. Of particular concern at this time is the question of inert ingredients. For a discussion of inert ingredients, see Text Box 8A in this section of the workbook.

Natural pesticides must be used in ways that are safe and legal. Natural does not necessarily mean safe, and you are strongly advised to read and follow the product label. This is especially true for broad-spectrum botanical pesticides, some of which are quite toxic to humans, beneficial insects, and other non-target organisms.

The Organic Standard requires that pest management decisions be made in a hierarchical fashion. See Text Box 7A for details on how pest and disease control decisions must be made in organic systems.

Text Box 8B

Choosing Sustainable Pest and Disease Management

As in weed management, the most sustainable pest and disease management practices are usually those that maintain a high degree of biodiversity in the field, use the least amount of energy and off-farm inputs, and are most cost effective. Some good examples of pest and disease management strategies that enhance biodiversity include companion planting and intercropping, selective use of cover crops, crop rotation, release of beneficial insects, and the maintenance of beneficial insect habitats in adjacent non-crop areas. Sanitation to remove pest habitat and sources of re-infestation and -infection, resistant crop varieties, pest monitoring, trapping strategies, and plant canopy management are also among the more sustainable practices one can use.

Organic farmers have access to a growing selection of alternative pesticides acceptable under the National Organic Standard. However, all pesticides reduce biodiversity and should be considered the least desirable option. Realistically, production of many high-value organic crops will require natural pesticidal inputs for the foreseeable future, at least until organic research provides alternatives.

☐ Yes ☐ No ☐ n / a 8.1 ***Does your production system keep disease and insect pests at manageable levels?***

☐ Yes ☐ No ☐ n / a 8.2 ***Do you use approved practices and materials to control disease and insect pests [§205.206]?*** Allowed practices and materials typically include but are not limited to the following:

- companion planting[59]
- intercropping[60]
- cover crops[61]—for example, cover crops of sudangrass, rapeseed, and mustard are especially effective at suppressing nematodes.
- crop rotation[62]
- establishing and maintaining beneficial insect and wildlife habitats[63]
- release of beneficial insects[64]
- animal predator (birds, bats, ducks, guinea fowl, etc.)
- Integrated Pest Management (IPM) monitoring[65]
- composting
- mulching—Mulching can reduce disease on tomatoes and similar crops by reducing soil contact and rain-splash. However, organic mulches can also serve as habitat for certain pests such as the squash bug and must be used with caution.
- plant canopy management—for example, crop rows can be spaced or oriented to encourage air movement and sunlight, both of which work to reduce many diseases.
- altered planting schedules—for example, in the mid-South delaying the planting of squash or pumpkins until after July 1 can avoid serious squash bug infestation.[66]
- resistant and tolerant crop varieties[67]—Genetically-engineered varieties are NOT allowed.
- sanitation[68]—Sanitation entails the removal of sources of disease infection or insect pest infestation. Examples include composting cull vegetables, removing grassy weeds from field edges, sanitizing propagation tools, etc.
- potting soil pasteurization
- trap crops[69]—These are small plantings of a crop or crop variety intended to draw a particular pest away from the main crop. Trap crops are often destroyed—along with the pests they accumulated—by flaming or other means.
- row covers, screening, and other physical barriers[70]
- solarization (for details, see question 7.2)
- mass trapping of insect pests[71]
- tillage[72]—Choose alternatives to tillage under circumstances where excessive soil erosion can occur.
- flaming—for example, flame weeding equipment has been used effectively to control alfalfa weevil[73] and Colorado potato beetle[74]
- vacuuming[75]
- flooding
- burning crop residues—The burning of crop residues is allowed only for two purposes: suppression of disease and stimulation of seed germination [§205.203(e)(2)].
- allowed pesticides (see Text Box 8C in this section of the workbook)
- esoteric practices (see Text Box 6B in Section VI of the workbook)

☐ Yes ☐ No
☐ n/a

8.3 ***Are all of the insect pest and disease control materials you are using allowed in organic production [§205.206]?*** When considering commercial products, the grower must make a special effort to determine whether any of the ingredients are prohibited inputs. (See Text Box 6C in Section VI and Text Boxes 8A and 8C in this section of the workbook.)

Allowed inputs typically include but are not limited to the following:[76]

- beneficial insects and other organisms[77]
- biological pesticides[78]—formulations must NOT contain GMO's nor be GMO-derived.
- botanical pesticides[79]—note that botanical formulations that include piperonyl butoxide are NOT allowed.
- dormant and summer oils[80]
- insecticidal soaps[81]
- mineral-based pesticides[82]
- pheromones

Prohibited pest and disease control materials include but are not limited to the following:

-
- x synthetic insecticides, fungicides, miticides, etc., unless specifically allowed on the National List [§205.105(a)]
- x heavy metal-based pesticides [§205.602], for example, arsenates, lead, etc.
- x synthetic wetting agents [§205.105(a)]
- x nicotine sulfate and other tobacco products [§205.602(f)]
- x strychnine [§205.602(e)]

Text Box 8C

Allowed Pesticides

The term *pesticides* refers to any agent used to kill or repel a pest; for example, insecticides kill insects, fungicides kill fungi, and herbicides kill plants.

Generally speaking, pesticides that derive from natural materials or living organisms are allowed in organic production if they do not contain synthetic additives or are not specifically dis-allowed on the National List under §205.602. Most synthetic pesticides are not allowed; those few that are can be found on the National List under §205.601.

There are several general classes of pesticides that cover most of the materials allowed in organic production. The largest classes are botanicals, biologicals, oils, fatty acids, minerals, and pheromones.

Botanicals: Botanical pesticides are those derived from plants. They include pyrethrum, rotenone, sabadilla, neem,[83] ryania, and garlic. Strychnine and nicotine are also botanicals, but are expressly prohibited in organic production [§205.602(e) and §205.602(f)]. Since botanical pesticides are relatively non-selective and can affect both natural predators and parasites in the field, they should be used minimally. Botanicals can also affect other non-target organisms. Rotenone, for example, is highly toxic to fish.

Continued on page 29

Text Box 8C continued

Biologicals: Biological pesticides contain disease organisms or toxins derived from disease organisms effective in pest control. Among the better known biologicals are *Bacillus thuringiensis* (Bt),[84] *Beauveria bassiana*,[85] *Trichoderma harzianum*,[86] and *Spinosad*.[87] Generally speaking, biologicals are more selective and safer to use than botanical insecticides. However, insect pests have been observed to develop resistance to biologicals, as they have to most synthetic pesticides. Therefore, biologicals should also be used sparingly to preserve them as tools for the long term.

Spray Oils: Vegetable- or animal-derived oils are generally allowed as suffocating (stylet) oils, summer oils, dormant oils, and surfactants. Also, some petroleum-derived oils, referred to as *narrow-range oils*, are allowed for the same purposes. Spray oils are commonly used to control scale and mite pests. Consult your certifier to be certain you are not planning to use a prohibited form of pesticidal oil.

Insecticidal Soaps: Fatty acid insecticidal soaps are synthetic pesticides specifically allowed in organic production [§205.601(e)(6)]. Insecticidal soaps can be hard on beneficial predatory mites, are mildly phytotoxic,[88] and should be used with caution.

Minerals: Mineral-based pesticides include sulfur, copper products, diatomaceous earth, and kaolin clay. Arsenic, lead, and sodium fluoaluminate are minerals that are specifically prohibited [§205.602(b), §205.602(c), and §205.602(d)]. While mineral-based pesticides are allowed, caution is required in their use. Sulfur can reduce the populations of some beneficial insects and may also burn plants if used during hot weather. Since copper may accumulate in some soils, monitoring of soil copper levels is advisable. Diatomaceous earth can cause respiratory problems in people and animals. Note also that some formulations of mineral products—particularly coppers—may not be allowed in organic production. Check with your certifier if uncertain.

Pheromones: Pheromones are hormones generally used in products called *mating disrupters*. Being totally natural, the hormones themselves are allowed in organic production. However, most (perhaps all) commercial mating disrupter products contain List 3 inerts. Some of these inerts—BHT specifically—have been recommended for addition to the National List in the future. Because the status of mating disrupters is uncertain, consult your certifier before using them.

Inert ingredients are often an issue with many of these pesticide classes. Read Text Box 8A in this section of the workbook for more details on inerts.

Notes on Pest and Disease Management

IX. Condition of Agroecosystem

Agroecosystem is a term that refers to the whole environment of the farm or the field. Implying an ecological or holistic perspective, it takes into account quality of the soil, water systems, non-crop components, and a host of other factors.

The following soil and crop assessment questions highlight several indicators that can help you determine whether your organic management system is functioning well. These questions can be reviewed annually and used to monitor your progress over time.

☐ Yes ☐ No ☐ n/a 9.1 ***Do your fields have good tilth?*** *Tilth* is defined as the physical condition of the soil regarding its fitness for growing a crop. Desirable tilth is characterized by good porosity, granular structure, absence of surface crust ing, and ease of cultivation.

☐ Yes ☐ No ☐ n/a 9.2 ***Are your fields free of subsurface plowpans and compaction layers?*** The most obvious indication of subsurface compaction is standing water. The presence of subsurface compaction can be confirmed by using a penetrometer.[89]

☐ Yes ☐ No ☐ n/a 9.3 ***Are your measurable organic matter/humus levels stable or increasing?***

☐ Yes ☐ No ☐ n/a 9.4 ***Are tillage operations becoming easier under organic management (that is, the soil is progressively easier to work)?***

☐ Yes ☐ No ☐ n/a 9.5 ***Are earthworms and earthworm burrows evident in the soil?*** There are some circumstances where earthworms will not be found even in well-managed soils. Soils that routinely flood in spring, very arid soils, and some soils in the northern tier of states that were heavily glaciated may lack earthworms.

☐ Yes ☐ No ☐ n/a 9.6 ***Does your soil emit a rich earthy smell when tilled or dug?***

☐ Yes ☐ No ☐ n/a 9.7 ***Is dung beetle activity evident where livestock are grazed?***[90] Dung beetle activity should be vigorous on well-managed organic permanent pastures and range. Less activity will be seen on pastures that are part of a mixed crop rotation, because tillage disrupts the life cycle of this insect. However, dung beetles are mobile and should be active on rotation pasture. Note: the synthetic worming agent, ivermectin, is harmful to dung beetles. Though ivermectin is permitted on a limited basis in organic production (see §205.603(a)(12)), it should be used sparingly.

☐ Yes ☐ No ☐ n/a 9.8 ***Is there adequate water drainage?***

9.9 ***Do root structures of crops and weeds show good development and penetration?*** ☐ Yes ☐ No ☐ n/a

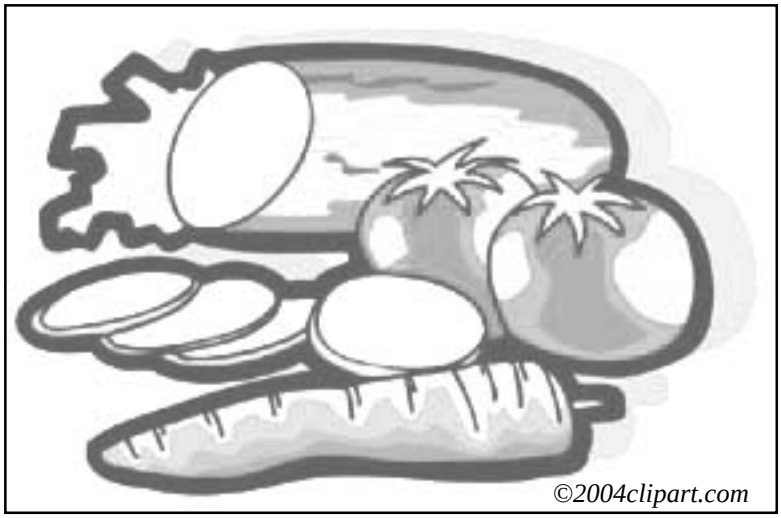
9.10 ***Are your crops free of nutrient deficiencies?*** Symptoms of nutrient deficiencies include chlorosis (yellowing), other discolorations of the leaves and stems, stunted growth, blossom-end rotting of fruits, and consistently low yields. ☐ Yes ☐ No ☐ n/a

9.11 ***Do your crops appear free from overfertilization?*** Symptoms may include excessive vegetative growth accompanied by poor fruit set, aphid infestations, or salt injury. ☐ Yes ☐ No ☐ n/a

9.12 ***Is there an abundance of beneficial predatory and parasitic insects under normal conditions?*** ☐ Yes ☐ No ☐ n/a

9.13 ***Is there an abundance of pollinating insects when crop is in flower?*** ☐ Yes ☐ No ☐ n/a

Notes on Condition of Agroecosystem



X. Livestock Manures

Livestock manure is one of the most valued resources on an organic farm or ranch. Conservation of manure and its proper application are key means of recycling nutrients, building soil, and improving the sustainability of an organic operation. Manures from conventional systems are allowed in organic production; this includes manure from livestock grown in confinement and from those that have been fed genetically engineered feeds. Manure sources containing excessive levels of pesticides, heavy metals, or other contaminants may be prohibited from use. Such contamination is most likely with manure obtained from industrial-scale feedlots and other confinement facilities. Certifiers may require testing for these contaminants if there is reason to suspect a problem.

Ideally, manures for organic crop production are composted before use. (See Section XI of this workbook for details on compost.) You may use uncomposted manure, but there are restrictions [§205.203(c)(1)].

You may not apply raw, uncomposted livestock manure to food crops unless it is:

A. **incorporated into the soil a minimum of <u>120 days</u> prior to harvest when the edible portion of the crop has soil contact.** The best examples are vegetables, especially crops like leafy greens, potatoes, carrots, radishes, and non-staked tomatoes. Any harvestable portion of a crop that can be splashed with soil during precipitation or irrigation might be considered to have soil contact.

OR

B. **incorporated into the soil a minimum of <u>90 days</u> prior to harvest of all other food crops.**

Incorporation is generally assumed to mean mechanical tillage to mix the manure into the soil. However, it might also include *biological* incorporation through the action of earthworms, dung beetles, and other organisms, though this can be seen as a liberal interpretation of §205.203(c)(1). Consult your certifier if incorporation might be an issue for you.

Take note that the 90- and 120-day restrictions apply only to crops used directly as human food; they do not apply to fiber crops, cover crops, or to crops used as livestock feed.

There are a number of commercial organic fertilizer products that contain manures which have been heated to destroy pathogens. At this time, it is unclear whether such products must be treated as raw manure, and therefore applied according to the 90- and 120-day rules. Consult your certifier before purchasing and using these products if this may be an issue.

While not specifically prohibited in the National Organic Program Regulations, fecal matter and other wastes from cats and dogs should not be used on organic food crops. There is significant danger of disease transmission to humans.

☐ Yes ☐ No ☐ n/a 10.1 ***Are all your manure applications to food crops in compliance with the 90 and 120-day rules [§205.203(c)(1)]?***

☐ Yes ☐ No ☐ n/a 10.2 ***Are your sources of manure free of contamination from excessive amounts of prohibited substances [§205.203(c)]?*** If a manure source is suspected of contamination with excessive amounts of prohibited substances, appropriate testing should be done. If test results indicate that the manure is free of excessive contamination and it is used in production, the test results should be kept on file.

10.3 ***Is manure applied according to soil and crop needs, thereby preventing nutrient imbalances or nutrient pollution [§205.203(c)]?***[91] Note: To achieve predictable application of manures, spreading equipment must be properly maintained and calibrated.[92] ☐ Yes ☐ No ☐ n/a

10.4 ***Is manure applied only under conditions that prevent runoff to surface waters [§205.203(c)]?***[93] ☐ Yes ☐ No ☐ n/a

10.5 ***If manure is stockpiled, are measures taken to avoid leaching losses and contamination of surface waters [§205.239(c)]?*** ☐ Yes ☐ No ☐ n/a

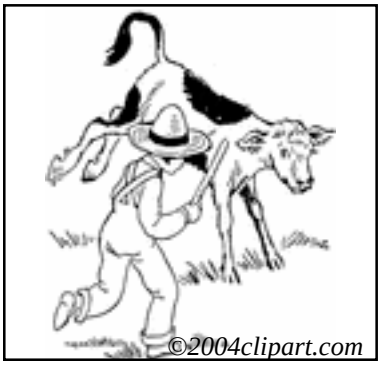
10.6 ***Are livestock manures free of human waste and biosolids [§205.203(e)(2)]?*** ☐ Yes ☐ No ☐ n/a

10.7 ***If you are using non-composted, commercially processed manure fertilizers, have you asked your certifier whether the 90- and 120-day rules apply?*** ☐ Yes ☐ No ☐ n/a

10.8 ***Are raw manure extracts or* teas *applied according to the 90- and 120-day rules [§205.203(c)]?*** ☐ Yes ☐ No ☐ n/a

10.9 ***Are records kept of manure applications that include date, tonnage, and fields receiving application?*** ☐ Yes ☐ No ☐ n/a

Notes on Livestock Manures



XI. Compost

Perhaps no other process is more closely associated with organic agriculture than composting.[94] Composting is one of the most reliable and time-honored means of conserving and recycling nutrients; managing weeds, pests, and diseases; building soil fertility; and converting wastes into resources. Because matured, well-made compost is a stable fertilizer that will not "burn" plants, and because composting kills most human and plant pathogens, it can be safely used as a late-preplant or sidedress fertilizer on food crops. The National Organic Standard defines *compost* as "the product of a managed process through which microorganisms break down plant and animal materials into more available forms suitable for application to the soil…"[§205.2]. There are no special restrictions on how and when compost can be used in organic crop production, in contrast to the 90- and 120-day restrictions on raw manure.

In order for manure-based compost to have the complete flexibility of use permitted by the Regulations, it must meet the criteria set out in §205.203(c)(2). This section of the Regulations specifies that:

1. **the initial carbon:nitrogen ratio of the blended feedstocks be between 25:1 and 40:1;**

   and

2. **the temperature must remain between 131° F and 170° F for 3 days when an in-vessel or a static aerated pile system is used. If a windrow composting system is used, the same temperature range must be maintained for 15 days, during which period the windrow must be turned at least five times.**

Manure-based compost produced using methods that do not meet the above criteria does not fit the Standard's definition of compost. It MUST be applied according to the 90- and 120-day raw manure rules.

Composts that have been made without manure as a feedstock are treated as "plant materials" in the National Standard, §205.203(c)(2) does not apply, and there are no special restrictions on their use.

National Organic Program policy on composting is intended to ensure the elimination of pathogens that cause illness in humans. The composting procedures in the Regulations are adapted from EPA and NRCS guidelines for composting biosolids.[95]

Because they have strong anti-fungal action, compost teas[96] have become a popular foliar spray for a number of organic crops, though there is considerable controversy over how they may be used. The National Organic Program—being very concerned with food safety—fears that compost tea might contaminate organic food crops with human pathogens. However, many experts on compost production and the use of compost tea argue that this will not be a problem when both compost and compost tea are properly made. If you plan to use compost tea on organic crops, it is critical that the compost used to produce the extract be made according to NOP requirements. You should also consider testing procedures for the extract to ensure that it is free of dangerous pathogens. And, of course, clearly outline all your intentions and procedures in your OSP. Even when all of these steps are taken, your certifier may still disallow use of compost tea within 120 days of harvest. This is a controversial issue and one you need to work on closely with your certifier.

Also a matter of some debate is the use of vermicompost.[97] (*Vermicompost* is compost made using worms to digest the feedstocks.) Vermicomposting is not mentioned in the Regulations, though it is often argued that, when properly made, manure-based vermicompost is as pathogen-free as compost made according to the NOP criteria under §205.203(c)(2).

The Compost Task Force of the National Organic Standards Board has recommended that manure-based vermicompost have equal footing with "NOP-approved" compost if the system is maintained at 70–90% moisture for 12 months in an outdoor windrow system; 4 months in an indoor container system or an angled wedge system; or 60 days in a continuous flow reactor. Because the NOSB recommendation has not become NOP policy (as of this writing), contact your certifier before using manure-based vermicompost in a manner not consistent with the raw manure rules.

Growers should also be aware that the NOP does not consider heat-treated, processed manure products to be compost. Refer to Section X of this workbook for more details.

11.1 ***If your compost contains manure, has it been prepared according to the aforementioned requirements of §205.203(c)(2)?*** If not, it may only be applied according to the 90- and 120-day raw manure rules. Note: this applies to composts purchased from off-farm sources as well as any made on-farm. ☐ Yes ☐ No ☐ n/a

11.2 ***Are all your compost feedstocks and ingredients either natural (nonsynthetic) or on the National List of allowed substances [§205.203(c) and §205.203(e)(1)]?*** ☐ Yes ☐ No ☐ n/a

11.3 ***Is your compost free of human waste and biosolids [§205.203(e)(2)]?*** ☐ Yes ☐ No ☐ n/a

11.4 ***Is on-farm production of compost situated and managed so that it does not cause contamination of surface waters [§205.239(c)]?*** ☐ Yes ☐ No ☐ n/a

11.5 ***Are stockpiled composts stored to prevent leaching losses [§205.239(c)]?*** ☐ Yes ☐ No ☐ n/a

11.6 ***Is compost applied according to soil and crop needs?*** Note: To achieve predictable application of compost, spreading equipment must be properly maintained and calibrated. ☐ Yes ☐ No ☐ n/a

11.7 ***Is compost applied only under conditions that prevent runoff to surface waters [§205.203(c)]?***[98] ☐ Yes ☐ No ☐ n/a

11.8 ***Do you keep compost production records that include daily temperature readings and frequency of windrow turnings?*** ☐ Yes ☐ No ☐ n/a

Notes on Compost

XII. Natural Resource Protection

Organic farming has long been recognized as an environmentally friendly approach to agriculture. In addition to non-use of synthetic pesticides, organic farming uses less petroleum energy, generates fewer leached nutrients, and results in less erosion than conventional farming. The National Organic Program Standard is written to ensure that little-to-no pollution results from organic farming.

☐ Yes ☐ No ☐ n/a 12.1 ***Do you apply approved fertilizers and manures so that runoff and leaching are prevented [§205.203(c) and §205.203(d)]?*** Note: see Section X of this workbook for additional details on manure handling and water protection.

☐ Yes ☐ No ☐ n/a 12.2 ***Do you manage all your fields to prevent soil erosion [§205.205(d)]?***

☐ Yes ☐ No ☐ n/a 12.3 ***Do you use catch crops where necessary to take up excess nutrients, especially nitrogen [§205.205(c)]?***

☐ Yes ☐ No ☐ n/a 12.4 ***Are your farm or ranch's riparian areas (stream banks) stabilized and protected?***[99]

☐ Yes ☐ No ☐ n/a 12.5 ***Are natural wetlands on your farm or ranch protected?***

☐ Yes ☐ No ☐ n/a 12.6 ***Are waterways on your farm or ranch protected from livestock and livestock wastes—for example, use of fencing and water tanks to restrict stock from fouling natural streams?***

12.7 ***Are well sites—both active and inactive—located a safe distance from areas where manure accumulates or is stored?*** ☐ Yes ☐ No ☐ n/a

12.8 ***Are well sites protected from field runoff and other sources of contamination?*** ☐ Yes ☐ No ☐ n/a

Notes on Natural Resource Protection

XIII. Seeds / Seedlings / Planting Stock

There are three basic rules that apply to most contingencies. The first basic rule is this: organic seed and planting stock MUST be used in organic production.[100] When an equivalent organic crop variety is not commercially available, untreated conventionally grown seed and planting stock may be used. See Text Box 13B for an explanation of *planting stock*; for clarification of *equivalency* and *commercial availability*, see Text Box 13A. Both Text Boxes can be found in this section of the workbook.

The second basic rule is that transplants used to produce an annual organic crop MUST have been organically grown. A variance to use conventional seedlings to grow an organic crop may be granted only if the original transplants were destroyed through "…drought, wind, flood, excessive moisture, hail, tornado, earthquake, fire or other business interruption…" [§205.204(a)(3) and §205.290(a)(2)]. Contact your certifying agent.

The third basic rule is that seeds, annual seedlings, and planting stock used in organic production may NOT be treated with prohibited substances. There is one exception. Treatment with prohibited substances is allowed when the application of those substances is a requirement of Federal or State phytosanitary regulations [§205.204(a)(5)].

Text Box 13A

Equivalency and Commercial Availability

Equivalent variety is generally understood to mean a cultivar of the same type with similar plant characteristics when compared to the original preferred variety. For these purposes, *type* refers to the basic plant type (for example, head lettuce type vs. leaf lettuce type); *characteristics* refers to factors such as color, pest resistance, and maturation.

According to the National Organic Program Regulations, an equivalent variety of seed or planting stock would be considered *commercially unavailable* if the farmer could not locate an organic supplier. It might also be considered commercially unavailable if the organic supplier could not provide seed in the quantities needed, or if the available seed quality were substandard. Factors that might make seed quality substandard include the presence of seed-borne disease, very low germination percentages, high noxious weed seed content, and the like. The higher cost of organic seed and propagation materials is NOT considered an acceptable reason for using nonorganic seed.

Ultimately, the certifier must make the final decision on whether the use of nonorganic seed or planting stock is justified. The farmer must present ample documentation to support his or her decision to use nonorganic seed, including a record of attempts to locate organic seed sources. Traditionally this entails records of phone calls, letters, or e-mails to and from seed suppliers documenting your attempts to find an organic source. Most certifiers want clear indication that you have contacted at least three suitable suppliers.

Organic growers must make certain that the seeds, transplants, and planting stock they use are not genetically engineered. Purchasing these items from a certified organic producer should ensure that the propagation materials are not genetically modified and have a minimal degree of GMO pollen contamination.

Seed treatments are also a concern. Conventional treatments are usually fungicidal; most fungicides used for this purpose are prohibited in organic production. Allowed treatments include natural materials—such as biological inoculants—and synthetic substances that are on the National List—such as seaweed extracts. The most common example of an allowed seed treatment is the inoculation of legume seeds with rhizobium bacteria. Since some rhizobium products might be genetically engineered or contain GE ingredients, it is important to make that determination in advance and obtain an approved product.

Many farmers ask whether the organic seed requirement also applies to cover crop seeds. According to information provided on the *Question and Answer* page of the National Organic Program website dated 10/18/02, organic seed IS required, as for any other seed or planting stock {§205.204}. However, some certifiers appear to treat this as general guidance and consider cover crop seed as "plant materials" for managing soil fertility, as per §205.203(b). Of course, all cover crop seed must not be treated with prohibited substances, and if grazed by organic livestock, there is no question that the organic seed rule fully applies. Be certain you understand your certifier's views on this matter.

A section of the Regulation that may need special attention is §205.204(a)(4), which deals with perennial planting stock. It reads

> [n]onorganically produced planting stock to be used to produce a perennial crop may be sold, labeled, or represented as organically produced only after the planting stock has been main-

tained under a system of organic management for a period of no less than 1 year…

The popular interpretation of this section has been that planting stock for perennial crops may be obtained from nonorganic sources, but must be under organic management for twelve months before the first harvest of an organic crop. This interpretation is consistent with many organic certifier standards prior to federal regulation. If you read this section carefully, however, it suggests an alternate interpretation. The alternative interpretation is that the twelve-month requirement applies to the *sale* of perennial planting stock, *not* to its use once it has been placed in production. In other words, it is possible that this provision is pertinent to nursery production and not to the production of fruits, nuts, or produce.

How your certifier chooses to interpret §205.204(a)(4) of the Standard can have significant implications if you are establishing an orchard, vineyard, berry planting, or other perennial system. Circumstances can be especially confusing when dealing with strawberries—a crop that can be grown as either an annual or a perennial. Be certain to contact your certifier in advance of purchasing perennial planting stock to learn in full detail what your constraints might be.

Text Box 13B

About Planting Stock

The National Organic Standard lumps plant propagation materials into three basic categories: seeds, annual seedlings, and planting stock. The term *seeds* is self-explanatory. *Annual transplants* are seedlings of annual crops that have been removed from their original place of production and replanted elsewhere [§205.2]. *Planting stock* is defined as "[a]ny plant or plant tissue other than annual seedlings but including rhizomes, shoots, leaf or stem cuttings, roots, or tubers, used in plant production or propagation" [§205.2]. Planting stock includes sweet potato slips, garlic cloves, white Irish "seed" potatoes, and flower bulbs, as well as tree seedlings, strawberry plants, and blackberry root cuttings.

13.1 ***Is all seed used either:***
- ***organically produced and/or***
- ***conventionally produced, non-GMO seeds that have NOT been treated with prohibited substances [§205.204(a)]?***

☐ Yes ☐ No ☐ n/a

13.2 ***Are only NON-genetically engineered seeds and planting stock used [§205.105(e)]?***

☐ Yes ☐ No ☐ n/a

13.3 ***Are all annual seedlings and transplants acquired from organic sources [§205.204(a)]?*** See text in this section for discussion of variances.

☐ Yes ☐ No ☐ n/a

13.4 ***If annual seedlings and transplants are grown on-farm, are they produced using organic methods and approved inputs [§205.204(a)]?***[101]

☐ Yes ☐ No ☐ n/a

13.5 ***Do you use ONLY organic seed in the production of edible organic sprouts [§205.204(a)(1)]?***

☐ Yes ☐ No ☐ n/a

13.6 ***Do you retain documentation of all seed, seedling, and planting stock purchases?*** ☐ Yes ☐ No ☐ n/a

13.7 ***Do you keep seed tags and empty packets on file?*** ☐ Yes ☐ No ☐ n/a

13.8 ***If seed or plant inoculants are used, have you determined that they are not genetically modified [§205.105(e)]?*** Note: Labels for seed inoculant do not typically clarify whether the product contains genetically engineered materials. In such instances, you MUST obtain an affidavit or further documentation from the distributor or manufacturer to prove that the product you are using is GMO-free. Such documentation must be kept on file. ☐ Yes ☐ No ☐ n/a

13.9 ***If seed or plant treatments are used, have you determined that they involve only allowed processes and materials [§205.105]?*** ☐ Yes ☐ No ☐ n/a

Notes on Seeds / Seedlings / Planting Stock

XIV. Greenhouse Production

Most of the principles and constraints of organic field crop production apply equally to greenhouse production. This is particularly true of compliance requirements outlined in the National Standard. It includes all practice standards related to fertility management and pest control, allowed and prohibited inputs, and provisions regarding seed and planting stock.

There are a number of specific challenges that organic greenhouse growers can face. Among the most difficult is pest management. Conventional greenhouse production relies heavily on pesticides to deal with such problems. In contrast, many organic producers focus on environmental management—introducing diversity and biological controls, excluding pests, and paying particular attention to sanitation.[102]

When both organic and conventional production is done at the same location, either in adjacent or shared greenhouse structures, there are additional challenges relating to contamination and commingling. You must take extra care to ensure that pesticide drift does not reach organic crops, that shared equipment is

adequately cleaned, and that other hazards of contamination are properly dealt with. Split production within a single greenhouse structure is not prohibited, but is largely discouraged due to the difficulties in controlling pesticide drift and water drainage. Handling, labeling, and segregation procedures must be well-established to guarantee that conventional and organic products are not commingled.

If you look at the origins of organic agriculture—its history and philosophy—you will readily find that it is soil-based and focuses on soil humus management. On this basis alone, pure hydroponic systems, which use no soil, could not be certified. Historically, most certifiers have adopted this viewpoint, and do not certify hydroponic operations. However, others have been willing to certify *some* hydroponic systems, especially those that are integrated with aquaculture and similar recycling systems. It appears that the National Organic Program considers hydroponic systems as certifiable as long as they meet the requirements of the National Standard. Be certain to discuss all details of a planned hydroponic system with your certifier.

Text Box 14A

Recycling and Waste Management

Though it strives to be more environmentally friendly, organic farming, like conventional farming, will still generate waste materials that cannot be recycled on-farm. Common examples include used plastic mulches, damaged irrigation tubing, natural pesticide containers, and old propagation flats. Recycling is the preferred option for plastic, aluminum, and glass wastes; landfilling should be used if recycling is not an option.

Burning of plastics is strongly discouraged. If you must burn plastics, be certain that you do not burn them with wood or other materials that you plan to return to the field or greenhouse. Ash that has been contaminated with plastics is prohibited in organic crop production [§205.203(d)(4)].

14.1 ***Do your greenhouse crops appear free of nutrient deficiency symptoms?*** ☐ Yes ☐ No ☐ n/a

14.2 ***Do your greenhouse crops appear free of the symptoms of overfertilization?*** ☐ Yes ☐ No ☐ n/a

14.3 ***Are all planting media ingredients[103] and fertilizers allowed in organic production [§205.105]?*** ☐ Yes ☐ No ☐ n/a

14.4 ***Does your production system keep disease and insect pests—including mites and other arthropods—at manageable levels?*** ☐ Yes ☐ No ☐ n/a

14.5 ***Do you use approved practices and materials to manage insect pests and diseases [§205.206]?*** Allowed practices and materials typically include but are not limited to the following: ☐ Yes ☐ No ☐ n/a

- diverse plantings
- maintaining beneficial insect habitat
- composting
- humidity control

- introduced predators and parasites
- IPM monitoring
- exclusion screening
- sticky traps[104]
- soil pasteurization, sterilization, and/or solarization (For details on solarization, see question 7.2, Section VII)
- sanitizing practices for tools and containers
- application of allowed pesticides
- esoteric practices (see Text Box 6B in Section VI of this workbook)

☐ Yes ☐ No ☐ n/a 14.6 ***If growing trays and pots are re-used, are they disinfected using approved practices and materials [§205.105 and §205.206(a)(2)]?***

☐ Yes ☐ No ☐ n/a 14.7 ***Do you manage weeds in and around the greenhouse site with allowed technologies and inputs [§205.206(c)]?*** Allowed practices and materials typically include but are not limited to the following:

- cultivation
- mowing/string trimming
- mulching
- thermal or flame weeding
- hoeing or hand-pulling
- herbicidal soaps (permitted around buildings and non-food crops only; prohibited on food crops [§205.601(b)(1)])

☐ Yes ☐ No ☐ n/a 14.8 ***Are your greenhouse structures adequately distanced or protected from sources of pesticide drift [§205.202]?***

☐ Yes ☐ No ☐ n/a 14.9 ***Are your greenhouse structures sited to avoid flooding or infiltration by contaminated runoff water [§205.202]?***

☐ Yes ☐ No ☐ n/a 14.10 ***Are plastics and other wastes from the greenhouse operation properly disposed of to prevent contamination of organic crops?*** See Text Box 14A in this section of the workbook.

☐ Yes ☐ No ☐ n/a 14.11 ***Is water runoff from your greenhouse site controlled so that it does not contaminate surface waters or cause soil erosion [§205.203(c)]?***

☐ Yes ☐ No ☐ n/a 14.12 ***Are greenhouse construction materials selected and managed to prevent contamination of producing soils and crops* [§205.206(f)]?** Lumber is of particular concern (see Section XV).

☐ Yes ☐ No ☐ n/a 14.13 ***If you do split production, are separate structures used to segregate conventional and organic production?***

14.14 ***Are adequate barriers present and/or procedures in place to prevent pesticide-laden air movement from conventional production areas into organically managed sections* [§205.202(c)]*?*** ☐ Yes ☐ No ☐ n/a

14.15 ***Are the organic production areas situated to prevent contamination by drainage from conventional areas?*** ☐ Yes ☐ No ☐ n/a

14.16 ***Are prohibited materials used for conventional production stored separately from organic inputs?*** ☐ Yes ☐ No ☐ n/a

14.17 ***Are separate work areas used to mix organic and conventional potting media and to prepare other inputs?*** ☐ Yes ☐ No ☐ n/a

14.18 ***If the same work areas are used for mixing organic and nonorganic media and inputs, are cleanup protocols defined and a cleanup log maintained?*** ☐ Yes ☐ No ☐ n/a

14.19 ***Are sprayers and other application equipment for organic use labeled and segregated?*** ☐ Yes ☐ No ☐ n/a

14.20 ***Does shared equipment have cleanup protocols clearly defined and up-to-date cleanup logs maintained?*** ☐ Yes ☐ No ☐ n/a

14.21 ***Where fertigation or pesticide injection is used in split or parallel production, are the water systems fully segregated to prevent contamination?*** ☐ Yes ☐ No ☐ n/a

14.22 ***Are procedures in place to prevent commingling of organic and conventionally produced plants or products [§205.201(a)(5)]?*** Procedures might include: ☐ Yes ☐ No ☐ n/a

- handling protocols and logs
- segregation
- color-coded harvest containers
- color-coded pots
- plant tags
- pot labels

Notes on Greenhouse Production

XV. Lumber and Wood Products for Field and Greenhouse Production

The use of commercial wood and wood products in organic agriculture presents some hazards of contamination from wood treatments, and caution is advised. The Organic Regulations are explicit; §205.206(f) states that producers must not use lumber that has been treated with arsenates or other prohibited materials where it can contact soil or livestock. The prohibition applies to new and replacement installations; treated wood on existing structures will not need to be replaced or shielded unless the certifier identifies a clear hazard.

Treated lumber may be used in circumstances and in ways that ensure contamination cannot and will not occur. Final judgement rests with the certifier. Certifiers are unlikely to permit half-measures that run the risk of failure. For example, treated trellis posts set in concrete still pose a hazard to growing crops, not only from the unshielded aerial portion, but also from the concrete shield which is likely to fissure and crack with time. Certifiers will be similarly concerned about the use of treated lumber in greenhouses and on growing beds. It is highly advisable to choose an alternative to treated lumber in all such cases.

There are several alternatives to treated lumber. Untreated wood can be used, but you need to know your trees. Some species—such as locust and red cedar—resist rotting; others—such as pine—will deteriorate rapidly. Wood may also be treated with approved materials or processes. At the time of this writing, there are none to be recommended. Finally, lumber alternatives can be chosen. Concrete, plastic, metal, and rock are all options, and will probably last longer than wood anyway.[105]

When sawdust or wood shavings are used as mulches, compost feedstocks, or soil amendments, the grower should consider that:

- wood is very high in carbon. If sawdust or chips are incorporated into the soil without supplemental nitrogen, current and subsequent crops could suffer from nitrogen deficiency.
- some tree species are allelopathic—that is, they produce natural chemicals that suppress the growth of other plants. Wood from these trees may harm a range of different crops. Fortunately, few trees exhibit significant allelopathy. The principal species of concern is black walnut.
- wood that has been treated with paints, pesticides, or other prohibited materials must not be used.

☐ Yes ☐ No ☐ n/a 15.1 ***Are sawdust, wood shavings, and/or wood chips used as soil amendments, potting soil amendments, or compost feedstocks free of contamination from paints, prohibited wood treatments, or prohibited pesticides [§205.105 and §205.203(d)]?***

☐ Yes ☐ No ☐ n/a 15.2 ***Are newly-installed fenceposts and anchors constructed of approved materials, located where they cannot contaminate organic crops or livestock, or fully shielded to prevent contamination [§205.206(f)]?***

☐ Yes ☐ No ☐ n/a 15.3 ***Are trellis posts and anchors constructed of approved materials or fully shielded to prevent crop contamination [§205.206(f)]?***

15.4 ***Are "timbers" used to border raised beds for intensive production constructed of approved materials or fully shielded to prevent crop contamination [§205.206(f)]?*** ☐ Yes ☐ No ☐ n/a

Notes on Lumber and Wood Products for Field and Greenhouse Production

XVI. Water Quality for Irrigation and Processing

The National Organic Program Regulations have very little to say about irrigation and irrigation water quality. However, since it is the general intent of these regulations that crops and soils not be contaminated with prohibited substances, producers should take precautions to ensure that irrigation water is not loaded with agricultural pesticides or other polluting chemicals. Your certifier may require additional testing of your water sources if contamination is suspected.

If you have a split operation and shared irrigation equipment is used for fertigation or other chemical application, protocols for decontamination of the equipment and a cleanout log will be required. (It is not a good idea to make dual use of irrigation equipment, especially where prohibited pesticides are used. Some certifiers may not permit dual use at all.) If you are using a cleaning agent or a substance intended to control microbial growth, consult your certifier to be certain it is allowed for use in organic production.

When it comes to water quality for organic food handling and processing, microbial contamination is of particular concern—in fact, it is a high profile issue in the organic community. Hydrogen peroxide, ozone, and chlorine are among the synthetic materials allowed in organic processing that are effective in controlling microbial contamination. The use of chlorine requires additional clarification.

§205.605(b)(9)—the portion of the National List that outlines non-agricultural synthetics allowed in organic processing—says that chlorine materials are allowed for "disinfecting and sanitizing food contact surfaces," and that "residual chlorine levels in the water shall not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act." (Currently the residual chlorine limit under the Safe Drinking Water Act is 4 parts per million, or ppm.) The language of this section has caused a great deal of misunderstanding and has led to a wide disparity of interpretation among certifiers. Some have assumed that this language means that chlorinated water greater than 4 ppm chlorine may not come in contact with organic food products and may be used only for sanitizing food preparation surfaces. Others have assumed that the language requires that food products be washed only with water that contains no more than 4 ppm chlorine—a level that is virtually ineffectual for sanitizing. Still other certifiers have believed that the Safe Drinking Water Act criterion allows highly chlorinated water to be used, but that the wastewater leaving the organic facility be less than 4 ppm chlorine.

The most rational interpretation (that we have heard, at least!) is that the notation in the regulation was improperly written; that the intent of the provision was that the rinse water that makes final contact with the organic product contain less than 4 ppm Cl. In other words, a food product, such as whole tomatoes, may be bathed in water containing a high concentration of chlorine for sanitation purposes. However, that product must receive a thorough final rinse of water containing less than 4 ppm Cl.

The producer should be aware that full clarification of the regulation regarding chlorine has not been made at the time of this writing. Therefore, be certain to consult with your certifier if you are using chlorine products for any sanitation purposes.

Boiler additives are not considered an organic issue in systems where the steam does not directly contact an organic product, for example, steam jacket systems. However, where steam is used in food contact (for example, injection systems), or where it is used to sterilize jars or food containers, most conventional boiler additives are prohibited or regulated. Contact your certifier prior to use.

☐ Yes ☐ No ☐ n/a 16.1 ***If both organic and conventional crops are irrigated using the same equipment, are you taking steps to ensure that prohibited materials do not contaminate organic crops [§205.105]?***

☐ Yes ☐ No ☐ n/a 16.2 ***Is all runoff from conventionally managed land properly diverted to prevent contamination of land and water resources used in organic production [§205.202(c)]?***

☐ Yes ☐ No ☐ n/a 16.3 ***Are coliform tests completed for all water used in food processing and washing?*** Annual testing is advisable, and may be required by the certifier.

☐ Yes ☐ No ☐ n/a 16.4 ***If you are using chlorine for sanitation purposes in on-farm processing, do you have a clear understanding of your certifier's expectations with regard to meeting the National Standard for residual chlorine levels [§205.605(b)(9)]?*** See the text in this section for clarification.

☐ Yes ☐ No ☐ n/a 16.5 ***Have you performed any and all additional water analyses requested by your certifier?***

16.6 ***If water treatment technologies are required, have they been installed and are they fully functional?*** ☐ Yes ☐ No ☐ n/a

16.7 ***Are you satisfied that your water sources are free of contamination by prohibited substances?*** ☐ Yes ☐ No ☐ n/a

Notes on Water Quality for Irrigation and Processing

XVII. Harvest

Organic producers have two significant concerns at harvest time beyond simply getting in the crop. The first concern is to avoid commingling their organic product with conventional production. This is primarily a problem on split-operation farms, and also where custom harvesting is employed. The second concern is to avoid any action that may damage the soil or otherwise create problems for next year. Lack of attention to harvesting details can create particular difficulties with weeds; for example, excessive compaction due to harvesting with heavy equipment in wet weather can stimulate certain problem weeds to grow.

Conventional hay harvesting sometimes involves the use of materials that might not be accepted in organic production. Preservatives and mold inhibitors, for example, may be prohibited. Individual products should be checked to determine whether they are natural or are listed as an allowed synthetic input. Another consideration is the use of baling twine that is treated with fungicide to prevent rotting. Use of treated twine may be prohibited. Be certain to check with your certifier.

The National Organic Program Regulations specifically allow for the labeling of wild-harvested crops as organic. A wild crop is "[a]ny plant or portion of a plant that is collected or harvested from a site that is not maintained under cultivation or other agricultural management" [§205.2]. As with cultivated crops, wild-harvested crops must come from designated areas that have clear boundaries and buffer zones, and that have not had prohibited materials applied for three years. Wild crop harvesting must not be destructive to the environment and must not deplete the species being harvested.

Text Box 17A

Cleanout Protocols

There is a *commingling* hazard when harvesting equipment is used for both conventional and organic crops. Cleanout procedures—referred to as *protocols*—need to be determined and written down to ensure that product mixing does not occur. Along with clearly written protocols, a log of cleanout dates will also be expected by the certifier.

Cleanout protocols can be creative as long as they are effective and thorough. For example, some organic grain growers harvest the first outside crop row (adjacent to any buffer rows) and sell it as conventional in order to *purge* their combine of any residual conventional or buffer row crop material. Purging is often used by organic farmers to scour combines and other harvesting equipment of conventional crops before beginning the organic harvest. The portion of organic crop used to purge the equipment is always considered to be conventional. Purging may not be an adequate cleanout technique in circumstances where the remains of genetically engineered crops need to be removed. Very small quantities of GMOs can be detected with current testing procedures.

☐ Yes ☐ No ☐ n/a 17.1 ***If equipment is used to harvest both conventional and organic products, are cleanout protocols established and cleanout logs maintained?***

☐ Yes ☐ No ☐ n/a 17.2 ***When harvesting equipment is purged*** (see Text Box 17A in this section of the workbook)***, have adequate records been kept on the quantity of organic product used in purging and how it was subsequently used or disposed of?***

☐ Yes ☐ No ☐ n/a 17.3 ***If non-certified custom harvesting is used, are thorough cleanout protocols established and a cleanout log maintained?*** Note: be certain the name and address of the custom service is available to the inspector/certifier, and that arrangements can be made for inspection of the harvesting equipment and records.

☐ Yes ☐ No ☐ n/a 17.4 ***If harvest-aid products are used (for example, desiccants, defoliants, etc.), are they approved for organic production [§205.105]?***

☐ Yes ☐ No ☐ n/a 17.5 ***Are records of harvest yields and dates for each field or production unit routinely kept?***

☐ Yes ☐ No ☐ n/a 17.6 ***Are crops harvested from buffer zones segregated, documented, and sold/used as nonorganic product?***

☐ Yes ☐ No ☐ n/a 17.7 ***Do you avoid harvesting when soils are wet to prevent rutting and damage to soil structure?***

17.8 ***Do you clean harvesting equipment between fields when there is danger of redistributing weed seeds to weed-free areas?*** ☐ Yes ☐ No ☐ n/a

17.9 ***If you are using plastic or fungicide-treated baling twine, are you disposing of it in a proper manner after use?*** Note: Neither plastic nor fungicide-treated twine (if allowed at all by your certifier) should find its way into the compost or manure wastes that are spread back onto the fields. (See Text Box 14A in Section XIV of this workbook.) ☐ Yes ☐ No ☐ n/a

17.10 ***If you are harvesting a wild crop that is sold, labeled, or represented as organic, is it harvested from a designated area that has had no prohibited substances applied to it for a period of 36 months immediately preceding the harvest [§205.207(a)]?*** ☐ Yes ☐ No ☐ n/a

17.11 ***If you are harvesting a wild crop that is sold, labeled, or represented as organic, is it harvested in a manner that is not destructive to the environment and will sustain the growth and production of the wild crop [§205.207(b)]?*** ☐ Yes ☐ No ☐ n/a

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Notes on Harvest

XVIII. Storage

There are three major areas of concern when storing organic crops: pest management, contamination, and commingling. Pest management decisions are based on four contingent levels of action (see Text Box 18A in this section of the workbook).

The second major concern is avoiding contamination of stored organic products with prohibited materials. The hazard of contamination from pest control agents has already been addressed. Additional hazards may arise through the improper storage of prohibited materials and other inadvertent forms of contamination. Common sense is your most valuable guide.

The third concern is avoiding commingling of organic and conventional crops. All bins and storage areas should be visibly labeled; inventory records, cleanout protocols, and cleanout logs must be current.

Text Box 18A

Structural Pest Management Decisions

Like weed, pest, and disease management, you are required to use a multi-level hierarchical approach in deciding how to deal with structural pests. In this case, there are four levels, which will be referred to as A, B, C, and D.

Level A: The first line of defense generally comprises preventive measures.
These Level A practices specifically include:

- removal of pest habitat, food sources, and breeding areas [§205.271(a)(1)]
- prevention of pest access [§205.271(a)(2)]
- management of environmental factors [§205.271(a)(3)]

Level B: Level B is the second line of defense, to be chosen if the preventive practices of level A are not sufficient to control pests. Level B practices generally include mechanical and physical practices.
Level B practices include:

- traps, light, sound, and similar physical controls [§205.271(b)(1)]
- natural and allowed synthetic lures and repellents [§205.271(b)(2)]

Level C: Level C is the third line of defense, to be chosen if the level of pest control required is not achieved after A and B control options are applied [§205.271(c)]. In such instances, you are allowed the wider use of nonsynthetic and allowed synthetics provided for on the National List.

Level D: In the event that pest control actions A, B, and C do not adequately prevent or control facility pests, a synthetic substance not on the National List may be applied ***PROVIDED THAT*** the producer and the certifier agree on the substance, method of application, and measures to be taken to prevent contact with organic crops, livestock, or other organic products [§205.271(d)]. If such action is taken, you must update your OSP to reflect the application, how it was made, and the contamination control measures used [§205.271(e)].

If use of a prohibited pesticide is required by federal, state, or local laws or regulations, this does not compromise your organic status as long as measures are taken to prevent contamination of the crops, livestock, and other organic products [§205.271(f)].

18.1 ***Are the floors, ceilings, and walls of all grain storage bins in good condition?*** ☐ Yes ☐ No ☐ n/a

18.2 ***Are grain storage bins sealed to prevent infestation by rodents, birds, and pest animals?*** ☐ Yes ☐ No ☐ n/a

18.3 ***Are the floors, ceilings, and walls of your feed storage bins and areas constructed of non-treated lumber or other materials that do not contaminate organic crops [§205.206(f)]?*** ☐ Yes ☐ No ☐ n/a

18.4 ***Are grain bins numbered and clearly marked?*** ☐ Yes ☐ No ☐ n/a

18.5 ***Where both conventional and organic grains are handled and stored, are organic and conventional storage bins clearly marked and segregated from each other?*** ☐ Yes ☐ No ☐ n/a

18.6 ***Where grain bins have mixed use (alternating conventional and organic storage), are there well-established cleanout protocols, cleanout logs, storage records, and visible labeling that clearly establishes whether the contents are organic or conventional?*** ☐ Yes ☐ No ☐ n/a

18.7 ***Are records for each bin and storage unit current and do they provide all necessary information?*** Bin records should contain the following information: ☐ Yes ☐ No ☐ n/a

- bin capacity
- status of crop (whether organic or conventional)
- types of product stored
- year of harvest
- amounts of grain added or removed
- dates on which grain was added or removed
- cleanout dates
- dates when pest control treatments were done
- source of crop (field identification)
- destination of crop

18.8 ***Are stored grains free of treatment with any prohibited materials [§205.105]?*** ☐ Yes ☐ No ☐ n/a

18.9 ***Where both organic and conventional hay or other fodder are stored, are the storage areas adequately segregated and labeled?*** ☐ Yes ☐ No ☐ n/a

18.10 ***Where the same storage area may be used for storage of either organic or conventional hay or fodder, are there well-established cleanout protocols, cleanout logs, storage records, and visible labeling that indicates organic or conventional status?*** ☐ Yes ☐ No ☐ n/a

☐ Yes ☐ No ☐ n/a

18.11 ***Are all produce coolers in good working condition?***

☐ Yes ☐ No ☐ n/a

18.12 ***Where both conventional and organic produce is handled and stored, are the storage areas clearly marked and segregated from each other?***

☐ Yes ☐ No ☐ n/a

18.13 ***Where coolers have mixed use (both conventional and organic), are there well-established cleanout logs, cleanout protocols, storage records, and visible labeling that indicates organic or conventional status?***

☐ Yes ☐ No ☐ n/a

18.14 ***Where organic produce is stored with conventional produce, are shelving, boxes, and other containers clearly labeled?***

☐ Yes ☐ No ☐ n/a

18.15 ***If different shelving levels are employed, is organic product always stored on upper shelves?*** Storing organic products on upper shelves reduces the chances of commingling; for example, an organic apple falling into a conventional lot means the loss of organic status and price premium for a single apple; a conventional apple falling into an organic lot is a violation of organic integrity, and means the loss of organic status and premium for the entire lot. Also, storing organic products on higher shelves reduces the chances of contamination from pesticide residues and other prohibited materials.

☐ Yes ☐ No ☐ n/a

18.16 ***Are prohibited materials (for example, fuels, pesticides, etc.) stored well away from organic crop storage areas?***

☐ Yes ☐ No ☐ n/a

18.17 ***Are appropriate sanitation procedures used?***

☐ Yes ☐ No ☐ n/a

18.18 ***Are organically acceptable pest control products and practices used [§205.206 and §205.271]?***[106] Allowed pest control techniques and products include but are not limited to:

- sanitation
- fencing/screening/netting
- scaring devices
- trapping
- barn cats
- release of beneficial predators/parasites
- diatomaceous earth
- pheromones
- vitamin D3 (for rodents)
- approved biological pesticides
- approved botanical pesticides

18.19 ***Are stored crops reasonably free of pest problems?*** ☐ Yes ☐ No ☐ n/a

18.20 ***Do storage facilities meet farm/ranch needs for capacity and ability to segregate crops as needed?*** ☐ Yes ☐ No ☐ n/a

18.21 ***If crops are stored off-farm, are the off-farm storage units either certified organic or included in your farm's inspection and certification?*** ☐ Yes ☐ No ☐ n/a

Notes on Storage

XIX. Post-Harvest Handling and On-Farm Processing

Before venturing into this topic area, it is helpful to understand one of the key terms used in the National Organic Program Regulations—that is, the term *handling*. §205.2 defines a *handler* as "[a]ny person engaged in the business of handling agricultural products, including producers who handle crops or livestock of their own production…" It defines a *handling operation* as "[a]ny operation or portion of an operation… that receives or otherwise acquires agricultural products and processes, packages, or stores such products." Therefore, when the Regulations refer to *handlers*, they are referring to a varied group of individuals and businesses that include both specialized organic food processors *and* farmers who do value-added processing. It should be noted that retailers (such as grocers) that do not process or repackage the organic goods they sell are not considered handlers and need *not* be certified.

It is also important to note that a difference exists between *post-harvest handling* and *on-farm processing*, although the distinction may not always be precise. *Post-harvest handling* typically refers to simple steps required to prepare a raw product for sale.[107] A classic example is the washing and bagging of salad mix for sale at a farmers' market. *Processing* usually involves more complex actions, such as cooking, grind-

ing, and complex packaging. Many on-farm processing components will require the submission of an organic *handling* system plan[108] in addition to the OSP that you prepare as a production plan. Be prepared to pay additional inspection and certification fees in such instances.

One of the major concerns in organic processing, regardless of scale, is identifying and sourcing approved ingredients. Pure organic agricultural products are the most desirable, of course. However, additional ingredients are often required to create a product, though they should be seen as secondary or marginal. This is how most consumers will see it.

All allowed nonorganic ingredients (with the exception of water and salt, which are considered natural and allowed) are addressed in the National List. §205.605 of the National List deals with non-agricultural substances that are allowed in organic processing, both natural (nonsynthetics) and synthetics. §205.606 deals with nonorganically produced agricultural products that are allowed.

As with organic production, OMRI has an important role to play in the evaluation of products for organic processing. *OMRI Listed* products can be purchased and used with a high degree of confidence. As a reminder, however, there are many acceptable products in the marketplace that have not been evaluated by OMRI and do not carry the *OMRI Listed* seal. When in doubt, contact your certifier to verify whether a particular product or material can be used.

Another question surrounds processing technologies. At present, only ionizing radiation and genetic engineering are specifically prohibited [§205.105(e) and §205.105(f)].

Further issues in on-farm processing include avoiding contamination and commingling and the management of waste products, among others. Unfortunately, the scope of this workbook is limited with regard to processing and we are not covering those details in any depth. If you are planning a complex processing operation, you are encouraged to consult someone in the industry with first-hand experience as well as your certifier.

☐ Yes ☐ No
☐ n/a

19.1 ***Are the post-harvest and processing technologies you use allowed in organic production* [§205.270(a)]?** Allowed technologies include but are not limited to:

- baking
- boiling
- canning
- chilling
- churning
- cooking
- curing
- cutting
- dehydrating
- distilling
- drying
- eviscerating
- extracting
- fermenting
- freezing
- grinding
- heating
- jarring
- mixing
- packaging
- preserving
- separating
- slaughtering
- smoking
- washing

☐ Yes ☐ No
☐ n/a

19.2 ***Do you avoid the use of ingredients that have been treated with ionizing radiation [§205.105(f)]?***

19.3 ***Has a flow chart of all on-farm processing steps and procedures been developed and is it available for review by the certifying body and its inspector(s)?*** ☐ Yes ☐ No ☐ n/a

19.4 ***Are all purchased raw commodities and ingredients certified organic or otherwise allowed for use in organic processing [§205.105 and §205.270]?*** ☐ Yes ☐ No ☐ n/a

19.5 ***Have you made certain that no prohibited substances are used in post-harvest handling or in on-farm processing [§205.105]?*** ☐ Yes ☐ No ☐ n/a

19.6 ***Are you taking care to determine that all ingredients are NOT genetically engineered and do not result from processes that use GMOs [§205.105(e)]?*** ☐ Yes ☐ No ☐ n/a

19.7 ***Are labels, invoices, and descriptions of all ingredients, processing aids, and cleaning agents kept on file?*** ☐ Yes ☐ No ☐ n/a

19.8 ***Does the water used for washing produce meet potable standards?*** See Section XVI. ☐ Yes ☐ No ☐ n/a

19.9 ***Are sanitation protocols used in all steps of post-harvest handling and/or on-farm processing?*** ☐ Yes ☐ No ☐ n/a

19.10 ***Are only food-grade equipment and inputs used in food processing?*** ☐ Yes ☐ No ☐ n/a

19.11 ***Where both organic and conventional products are handled, are protocols for segregation of products and cleanup of processing equipment clearly established, and are they adequate to prevent contamination and commingling?*** ☐ Yes ☐ No ☐ n/a

19.12 ***Where both organic and conventional products are handled, are logs of processing runs, cleanouts, and/or purges maintained and up-to-date?*** ☐ Yes ☐ No ☐ n/a

19.13 ***Are prohibited substances stored well away from processing equipment, processing inputs, raw products, and finished products?*** ☐ Yes ☐ No ☐ n/a

19.14 ***Is processing equipment well-maintained to prevent contamination of organic products with lubricants or other contaminants?*** ☐ Yes ☐ No ☐ n/a

☐ Yes ☐ No ☐ n/a

19.15 ***Are organic waste products from processing managed in ways that do not cause pollution, pose a health hazard, or provide pest habitat or food source?*** Preferred methods of processing organic wastes entail returning everything with nutrient value back to the soil if possible. Other desirable options include feeding vegetative wastes to livestock or composting.

☐ Yes ☐ No ☐ n/a

19.16 ***Is wastewater from processing managed in ways that do not cause pollution or pose a health hazard?***

☐ Yes ☐ No ☐ n/a

19.17 ***Are nonorganic processing wastes managed so they do not contaminate organic products and do not create a pollution problem?*** See Text Box 14A in Section XIV of this workbook.

Notes on Post-Harvest Handling and On-Farm Processing

XX. Equipment

Equipment used for the production and handling of organic products must not be a source of contamination or a means by which organic and conventional products are commingled.

☐ Yes ☐ No ☐ n/a

20.1 ***If harvesting, hauling, and crop handling equipment is also used for conventional crops, are cleanout protocols established and logs maintained?***

☐ Yes ☐ No ☐ n/a

20.2 ***If split or parallel production is done, is separate spraying equipment designated and clearly marked?***

20.3 ***If sprayers, planters, or dry material applicators are also used to apply prohibited materials, are cleanout protocols clearly established and cleanout logs maintained?*** When seed planters and transplanters feature insecticide or fertilizer boxes and tanks that are NOT used for organic production, many certifiers prefer that these be removed or the drive chains be disconnected when operating on organic acreage.

☐ Yes ☐ No ☐ n/a

20.4 ***Are all tractors, trucks, and other equipment free of fuel, coolant, and lubricant leaks?***

☐ Yes ☐ No ☐ n/a

20.5 ***Are all internal combustion engines properly tuned and maintained to ensure optimal fuel efficiency and reduce air pollution?***

☐ Yes ☐ No ☐ n/a

20.6 ***Is routine engine cleaning and maintenance of equipment done where it cannot contaminate production fields or harvested crops?***

☐ Yes ☐ No ☐ n/a

20.7 ***Are fuels, lubricants, paints, coolants, and empty containers that held these fluids stored where they cannot contaminate organic crops or products?*** See Text Box 14A in Section XIV of this workbook.

☐ Yes ☐ No ☐ n/a

Notes on Equipment

XXI. Transportation of Products

The hazards of contamination and commingling are the major concerns where transportation of organic product is concerned. Even small details can be very important. For example, cleanout protocols need to include cleanup of the tarps used to cover grain trucks. Even a small amount of GMO crop dust on organic crops can be detected and lead to a lost sale.

☐ Yes ☐ No ☐ n/a 21.1 ***Are cleanout, sanitation, and pest control protocols for farm-owned trucks and transportation units implemented, and are such activities regularly logged?***

☐ Yes ☐ No ☐ n/a 21.2 ***Are records of, and contact information for, hired truckers or trucking companies up-to-date?***

☐ Yes ☐ No ☐ n/a 21.3 ***Do the trucking companies you use understand and agree to the requirements for organic handling?*** This should be documented through signatures on bills of lading (BOLs), clean-truck affidavits, or similar documents.

☐ Yes ☐ No ☐ n/a 21.4 ***Do all hired trucks have either clean truck affidavits[109] or cleanout logs?***

☐ Yes ☐ No ☐ n/a 21.5 ***Where both organic and conventional products are shipped, are loading procedures designed to prevent accidental commingling?***

☐ Yes ☐ No ☐ n/a 21.6 ***Are you satisfied that there is little or no possibility of contamination of organic products being shipped from your farm, or of commingling with nonorganic products?***

Notes on Transportation of Products

XXII. Buildings and Facilities

Production buildings and facilities where organic products are handled must not become a contamination hazard or a source of pest infestation.

22.1 ***Are fuels, lubricants, cleaning agents, and other potential food contaminants safely stored in buildings other than those used for product handling, processing, and storage?*** ☐ Yes ☐ No ☐ n/a

22.2 ***Are fuel storage units safe and adequately maintained to avoid accidental spillage or leakage that might cause contamination hazards or environmental damage?*** ☐ Yes ☐ No ☐ n/a

22.3 ***Are the pest control products and procedures used in and around all facilities organically acceptable?*** See Text Box 18A for decision-making protocols for structural pest management. ☐ Yes ☐ No ☐ n/a

22.4 ***Are buildings maintained so as not to become a haven for rodents or other pests?*** ☐ Yes ☐ No ☐ n/a

22.5 ***Do you control weeds around buildings with organically acceptable methods and materials?*** ☐ Yes ☐ No ☐ n/a

22.6 ***If you were obliged to use a synthetic pest control material for managing pests in or around buildings or facilities, was it because management strategies and allowed materials were inadequate [§205.271(d)]?*** Note: You are also allowed to use otherwise prohibited pest control materials for facility pest management if so-required by Federal, State, or local laws and regulations. Measures must be taken to prevent the contamination of organic products and ingredients [§205.271(f)]. ☐ Yes ☐ No ☐ n/a

22.7 ***If you were obliged to use a synthetic pest control material for managing pests in or around buildings or facilities, was it with the approval of your certifying agent [205.271(d)]?*** ☐ Yes ☐ No ☐ n/a

22.8 ***If you have used pest control materials in or around buildings or facilities, are pesticide-use records maintained?*** ☐ Yes ☐ No ☐ n/a

22.9 ***Are nonorganic wastes managed so they do not contaminate organic products and do not create a pollution problem?*** See Text Box 14A in Section XIV of this workbook. ☐ Yes ☐ No ☐ n/a

Notes on Buildings and Facilities

XXIII. Packaging and Labeling

Producers that package and label their products have several things to consider besides the challenge of designing eye-catching, customer-friendly logos. The packaging used for organic products must not contaminate the contents or otherwise compromise organic integrity. Packaging materials must not be impregnated with prohibited pesticides and should not be stored in a manner that invites pest infestation.

The Regulations have very strict guidelines on labeling. There are four categories of labeling based on product composition:

- "100% Organic" is any product that contains 100% organic ingredients (excluding salt and water, which are considered natural). Most raw, unprocessed products off-the-farm can be designated "100% Organic". Likewise, many value-added farm products that have no added ingredients—such as grain flours, rolled oats, etc.—can also be labeled "100% Organic."
- "Organic" can be used to label any product that contains a minimum of 95% organic ingredients (excluding salt and water). Up to 5% of the ingredients may be nonorganic agricultural products that are not commercially available as organic and/or non-agricultural products that are on the National List of Substances Allowed in Processed Products.
- "Made With Organic _____" can be used on the label of a product that contains at least 70% organically produced ingredients (excluding salt and water). There are a number of detailed constraints regarding the ingredients that comprise the nonorganic portion. Producers should consult §205.304 of the Regulations for details.
- The specific organic ingredients may be listed in the ingredient statement of products containing less than 70% organic contents—for example, "Ingredients: water, barley, beans, or ganic tomatoes, salt." See §205.305 of the Regulations for more details.

The USDA's official organic seal may only be used on products that can be labeled "100% Organic" or "Organic." Products labeled "100% Organic" or "Organic" may also feature the logo of the certifying

agent on the label. Small producers exempted from certification (that is, marketing less than $5000 of organic product) may not use the USDA seal and may not state in any manner that their product is certified.

USDA Organic Seal

The labeling of organic products is rather detailed where processed products are involved. This is especially true when a number of different ingredients—some of them nonorganic—are used. This workbook will not venture into these complexities. For guidance on labeling, refer to Subpart D of the National Standard: §205.301 for labeling based on percent organic product composition; §205.302 regarding calculations for percentage of ingredients; §205.303-§205.305 for additional details on package labeling. §205.306 addresses the labeling of livestock feeds; §205.307 addresses the labeling of non-retail containers; §205.308-§205.309 deals with point of retail labeling; §205.311 addresses the specifics on use of the USDA seal.

For most organic farmers who market raw and unprocessed products, labeling issues are not complex. In most instances where these producers are required to supply a label, the words "100% Organic" or "Organic" will be appropriate. Even in such circumstances, it is important to read and understand the specifics of labeling in the Organic Regulations and to confer with your certifier.

23.1 ***Are all packaging materials free of impregnated pesticides or other prohibited substances [§205.272(b)(1)]?*** ☐ Yes ☐ No ☐ n/a

23.2 ***Are all packaging materials stored where they will remain free from contamination or infestation by pests?*** ☐ Yes ☐ No ☐ n/a

23.3 ***If you are re-using any bags or containers, are you taking measures to ensure that there is no risk of commingling with nonorganic products or of contamination with prohibited substances [§205.272(b)(2)]?*** ☐ Yes ☐ No ☐ n/a

23.4 ***Is all labeling in compliance with the National Organic Program Regulations [§205.300, §205.301, §205.302, §205.303, §205.304, §205.305, and §205.306]?*** ☐ Yes ☐ No ☐ n/a
Be sure to read the appropriate sections of the Regulations and confer with your certifier.

23.5 ***Where sales of both organic and conventional products occur, do adequate labeling and protocols exist to ensure segregation?*** ☐ Yes ☐ No ☐ n/a

Notes on Packaging and Labeling

XXIV. Marketing

Organic certification and regulation have arisen largely in response to a growing organic marketplace in which the producer and the end consumer never meet face-to-face. This marketplace is similar in many ways to the conventional marketplace, though the players are different and the infrastructure is not as well developed, as a rule.[110]

Traditionally, organic agriculture has been associated with local/regional food systems and relationship-based direct marketing. Relationship-based marketing covers those strategies in which customers and farmers actually meet and may even get to know each other. Direct marketing strategies are NOT required under the National Standard. However, there is good reason to consider direct marketing if you grow fresh produce and are located near a city or other market opportunity. Local and regional marketing shortens the distance food products travel, improves quality for the consumer, and typically leaves more of the food dollar in the producer's pocket. The following are several local and regional marketing options:

- Community Supported Agriculture (CSA)[111]
- direct sales to local stores, processors, and restaurants[112]
- farmers' markets[113]
- roadside sales[114]
- U-Pick/pick-your-own farming[115]

Notes on Marketing

XXV. Documentation, Recordkeeping, and Audit Trail

Whether you are an organic or a conventional farmer, the amount of recordkeeping required is increasing. In the conventional realm, much of the increase relates to regulation of fertilizer nutrients and pesticides. In organic systems, the recordkeeping is necessary to ensure organic integrity.

The National Organic Standard is specific with regard to requirements for recordkeeping on an organic operation. The records must: 1.) be well-adapted to the business being conducted; 2.) disclose all activities and transactions in adequate detail; 3.) be maintained for not less than five years beyond their creation; and 4.) be sufficient to demonstrate compliance with federal regulations [§205.103]. The actual amount of documentation the individual producer will need to generate and file to meet these requirements is not exact and depends on the complexity of the operation—number, kinds, and sizes of enterprises, etc.

The *audit trail* refers to the documentation necessary to determine the source, movement, and transfer of ownership of any organic product. A complete and thorough audit trail allows a processed product—a bag of organic corn chips, for example—to be traced back to the farm and fields from which the corn was harvested; it is about traceability. Sometimes the concept of audit trail is also extended to include production records and inputs, which also serve to demonstrate that the producer is farming organically.

Lot numbers are an important aspect of a good audit trail. Lot numbers are codes assigned by producers to link products to the fields of origin and the year or date on which they were produced. Lot numbers may not be necessary if you direct market, but are essential if you sell into wholesale markets or to processors. A good lot numbering system is logical and can readily be decoded. For example, Lot No. OC0603 might code for Organic Corn, from bin #06, which was harvested in 2003. Lot No. B041433 might code for Broccoli, from field 04, harvested on the Julian Calendar date 143 (May 23), in the year 2003.[116]

The following are among the common forms of documentation that organic crop producers must keep to ensure a complete audit trail and record system[117]:

- accurate maps with fields, production beds, and / or greenhouse units clearly marked with a consistent numbering or lettering system
- accurate history sheets for fields, production beds, and / or greenhouse units. History includes record of crops, cover crops, seeds or seedlings used, materials applied, yields, dates of field operations, etc.
- copies of correspondence and notices to neighbors, county road maintenance authorities, utilities, and others that demonstrate efforts to ensure the protection of organic fields from spraying and other forms of contamination
- soil and water test reports
- verification of the organic status of seeds, seedlings, transplants, and other purchases that require such documentation
- documentation of efforts to procure organic seeds and planting stock when nonorganic materials have been used
- verification of non-GMO status of nonorganic inputs
- pest and disease monitoring reports
- production logs and activity records
- harvest records
- packout records

- cull reports
- labels from purchased fertilizers, pest control products, and other inputs
- receipts for purchased inputs and / or services
- clean truck affidavits
- outgoing bills of lading
- weigh tags
- storage records
- equipment and storage unit cleanout logs
- sales receipts and / or invoices
- sales records
- complaint log[118]

☐ Yes ☐ No ☐ n / a 25.1 ***Does your lot numbering system permit accurate tracking of products from harvest through storage and marketing?***

☐ Yes ☐ No ☐ n / a 25.2 ***Is your farm audit control system adequate for tracing any product sold from your farm back to the field of origin?***

☐ Yes ☐ No ☐ n / a 25.3 ***Are records of sales maintained to ensure a complete audit trail?***

☐ Yes ☐ No ☐ n / a 25.4 ***Are you maintaining a complete set of operation records covering the production, harvesting, and handling of all agricultural products that you intend to be sold, labeled, or represented as organic [§205.103(a)]?***

☐ Yes ☐ No ☐ n / a ***25.5*** ***Is your recordkeeping system appropriate and well-adapted to the needs of your operation [§205.103(b)(1)]?***

☐ Yes ☐ No ☐ n / a 25.6 ***Does your recordkeeping system fully disclose all activities and transactions in sufficient detail so as to be readily understood and audited [§205.103(b)(2)]?***

☐ Yes ☐ No ☐ n / a 25.7 ***Have you retained or are you preparing to retain all records applicable to your operation for at least 5 years [§205.400(d) and §205.103(b)(3)]?***

☐ Yes ☐ No ☐ n / a 25.8 ***Is your recordkeeping system sufficient to demonstrate compliance with the Organic Standard and the Organic Foods Production Act [§205.103(b)(4)]?***

☐ Yes ☐ No ☐ n / a 25.9 ***Are your records available for inspection and copying during normal business hours by authorized representatives of the Secretary of Agriculture, the State organic program, and/or the certifying agent [§205.103(c)]?***

Notes on Documentation, Recordkeeping, and Audit Trail

Finding Referenced Information Sources

A number of resources are mentioned in the endnote text of this document. Contact information to obtain these materials is provided below.

Acres USA: Acres USA is a private business that publishes a monthly sustainable farming magazine under the same name. Acres USA also publishes and distributes a wide number of books on alternative agriculture and related subjects. To obtain a free book catalog and other information contact:
Acres USA
P.O. Box 91299
Austin, TX 78709-1299
Tel: 512-892-4400
Fax: 512-892-4448
E-mail: info@acresusa.com
Website: http://www.acresusa.com/magazines/magazine.htm

Alternative Farming Systems Information Center: AFSIC is one of several information centers at the National Agricultural Library (NAL) that provide in-depth coverage of specific subject areas relating to the food and agricultural sciences. AFSIC focuses on alternative farming systems that aim at maintaining agricultural productivity and profitability, while protecting natural resources. Such systems include sustainable, low-input, regenerative, Biodynamic, and organic farming and gardening.
Alternative Farming Systems Information Center
National Agricultural Library, Room 304
10301 Baltimore Avenue
Beltsville, MD 20705-2351
Tel: 301-504-6559
Fax: 301-504-6409
E-mail: afsic@nal.usda.gov
Website: http://www.nal.usda.gov/afsic/

ATTRA: ATTRA (Appropriate Technology Transfer for Rural Areas) is a USDA-funded project that is managed by the National Center for Appropriate Technology—a non-profit organization. ATTRA publishes and distributes information on organic and sustainable agriculture. Many of its publications can be directly downloaded from its website. Hard copies and other information and services can be obtained at no charge by calling the toll-free phone number.
ATTRA
P.O. Box 3657
Fayetteville, AR 72702-3657
Tel: 800-346-9140
Tel: 479-442-9824
Fax: 479-442-9842
Website: http://attra.ncat.org/

Cooperative Extension Service: Every state has one or more land grant universities that provide extension outreach for farmers. Local access to each state's services is usually available at the county level in the person of the "County Agent." Cooperative Extension typically has good information on basic production practices—seeding dates, recommended crop varieties, cover crop varieties, conservation practices, etc. While resources pertinent to organic production have been limited, the situation in most states is improving. A listing of addresses for state cooperative extension publications offices is appended to this workbook.

National Organic Program: The National Organic Program (NOP) was created to implement the Organic Foods Production Act of 1990, which is the over-arching legislation behind the federal standards. The NOP's website is the place to go for viewing the Regulations, and to monitor the progress and recommendations of the National Organic Standards Board.
Richard Matthews, Program Manager
National Organic Program
USDA-AMS-TMP-NOP
Room 4008—South Building
1400 and Independence Avenue, SW
Washington, DC 20250-0020
Tel: 202-720-3252
Fax: 202-205-7808
E-mail: NOP.Webmaster@usda.gov
Website: http://www.ams.usda.gov/nop/indexIE.htm

Organic Materials Review Institute: The Organic Materials Review Institute (OMRI) is a nonprofit organization whose primary mission is to publish and disseminate generic and specific (brand name) lists of materials allowed and prohibited for use in the production, processing, and handling of organic food and fiber. OMRI also conducts scientific research and education on the use of materials by the organic industry. Subscriptions to OMRI include the current generic and brand name supplier lists, with periodic updates and a quarterly newsletter.
OMRI
Box 11558
Eugene, OR 97440
Tel: 541-343-7600
Fax: 541-343-8971
E-mail: info@omri.org
Website: http://www.omri.org/

SAN: SAN (Sustainable Agriculture Network) is the outreach arm of the SARE (Sustainable Agriculture Research and Education) program, which has been the USDA's primary means of studying and spreading the word about sustainable farming systems. SAN publishes and distributes a number of for-sale books and free publications. Contact:
Sustainable Agriculture Publications
210 Hills Building
University of Vermont
Burlington, VT 05405-0082
Tel: 802-656-0484
E-mail: lhendric@zoo.uvm.edu
Website: http://www.sare.org/

Soil Foodweb, Inc.: Soil Foodweb, Inc. publishes books and articles, gives lectures, and does laboratory testing of soils and composts. Publication topics include soil microbiology, soil ecology, farming, orchards, golf/turf, nursery/landscape, forestry, and lawn and garden.
Soil Foodweb, Inc.
1128 NE 2nd St., Suite 120
Corvallis, OR 97330
Tel: 541-752-5066
Fax: 541-752-5142
E-mail: info@soilfoodweb.com
Website: http://www.soilfoodweb.com/sfi_html/index.html

The Soil and Health Library: This is an electronically accessible free public library offering a tightly focused collection of books on holistic agriculture, holistic health, self-sufficient living, and personal development. Most of the titles in this library are out of print. Some can be quite hard to find; many of these books are old enough to be public domain materials. It is an excellent place to find classic organic farming texts by pioneers such as Albert Howard, Eve Balfour, F.H. King, J.I. Rodale, and Newman Turner.
Website: http://www.soilandhealth.org/

Cooperative Extension Publications Offices and Websites:

Alabama Cooperative Extension Publications
Auburn University
122 Duncan Hall Annex
Auburn University, AL 36849
Tel: 334-844-5690
http://www.aces.edu/dept/extcomm/publications/

University of Alaska Cooperative Extension Service
Attn: Distribution
University of Alaska Fairbanks
PO Box 756180
Fairbanks, AK 99775-6180
Tel: 907-474-7268
Fax: 907-474-2631
E-mail: fycit@uaf.edu
http://www.uaf.edu/coop-ext/publications/

University of Arizona
CALSmart
4042 N. Campbell Avenue
Tucson, AZ 85719-1111
Tel: 520-318-7275
Fax: 520-795-8508
E-mail: pubs@ag.arizona.edu
http://ag.arizona.edu/pubs/

Arkansas Cooperative Extension Publications
University of Arkansas
Division of Agriculture
Cooperative Extension Service
2301 South University Avenue
Little Rock, Arkansas 72204
Tel: 501-671-2000
Fax : 501-671-2209
http://www.aragriculture.org/publications/default.asp

University of Arkansas Agricultural Engineering Publications
http://www.aragriculture.org/agengineering/default.asp
(Same address as above.)

University of California, Agriculture and Natural Resources
ANR Communication Services
6701 San Pablo Avenue
Oakland, CA 94608-1239
Tel: 510-642-2431 or 800-994-8849
E-mail: anrcatalog@ucdavis.edu
http://anrcatalog.ucdavis.edu
or
1441 Research Park Drive
Davis, CA 95616
Tel: 530-757-8930

Colorado State University Cooperative Extension
1 Administration Building
Colorado State University
Fort Collins, CO 80523-4040
Tel: 970-491-6281
Fax: 970-491-6208
http://www.cerc.colostate.edu/

University of Connecticut Cooperative Extension
Communications and Information Technology
1376 Storr Road, Unit 435
University of Connecticut
Storrs, CT 06269-4035
Tel: 860-486-3336
Fax: 860-486-0100 or 860-486-3334
E-mail: store@canr.cag.uconn.edu
http://www.canr.uconn.edu/ces/
(CES homepage)

University of Delaware
College of Agriculture and Natural Resources
Cooperative Extension
Newark, DE 19716
Tel: 302-831-2791
http://ag.udel.edu/extension/Information/publications_from_the_university.htm

University of Florida Extension
Institute of Food and Agricultural Sciences
Gainesville, FL 32611
E-mail: cmh@gnv.ifas.ufl.edu
http://edis.ifas.ufl.edu/

University of Georgia
College of Agricultural and Environmental Sciences
Cooperative Extension Service
Athens, GA 30602
http://www.ces.uga.edu/ces/pubs.html

Publications and Information Office
College of Tropical Agriculture and Human Resources
3050 Maile Way, Gilmore Hall 119
University of Hawaii at Manoa
Honolulu, HI 96822
Tel: 808-956-7046
E-mail: ctahrpub@hawaii.edu
http://www2.ctahr.hawaii.edu/oc/

University of Idaho Extension
Agricultural Publications
University of Idaho
Moscow, ID 83844-2240
Tel: 208-885-7982
Fax: 208-885-4648
E-mail: cking@uidaho.edu
http://info.ag.uidaho.edu/Catalog/catalog.htm

University of Illinois
Office of Extension and Outreach
214 Mumford Hall (MC-710)
1301 W. Gregory Dr.
Urbana, IL 61801
Tel: 217-333-5900
E-mail: extension@aces.uiuc.edu
http://www.extension.uiuc.edu/pubs.html

Purdue Cooperative Extension (Indiana)
Tel: 888-398-4636)
E-mail: extension@aes.purdue.edu
http://www.agcom.purdue.edu/AgCom/Pubs/menu.htm

Iowa State University Extension
Extension Distribution Center
119 Printing and Publications Building
Iowa State University
Ames, Iowa 50011-3171
Tel: 515-294-5247
Fax: 515-294-2945
E-mail: pubdist@iastate.edu
http://www.exnet.iastate.edu/pubs/

Kansas State University Extension
Production Services
Kansas State University
24 Umberger Hall
Manhattan, KS 66506-3402
Tel: 785-532-5830
Fax: 785-532-7938
E-mail: orderpub@lists.oznet.ksu.edu
http://www.oznet.ksu.edu/library/

University of Kentucky
College of Agriculture
Cooperative Extension Service
Ag Communications Services
131 Scovell Hall
Lexington, KY 40546-0064
Tel: 859-257-4736
Fax: 859-323-1051
http://www.ca.uky.edu/coahome/pubs.htm

Louisiana State University
Cooperative Extension Service
LSU Agricultural Center
P.O. Box 25203
101 Efferson Hall
Baton Rouge, LA 70894-5203
Tel: 225-578-2263
E-mail: communications@agctr.lsu.edu
http://www.lsuagcenter.com/

University of Maine Cooperative Extension
UMCE Communications Office
5741 Libby Hall, Room 110
Orono, ME 04469-5741
Tel: 207-581-3269
Fax: 207-581-1387
E-mail: tnelson@umext.maine.edu
http://www.umext.maine.edu/publications/catalog.htm

University of Maryland Cooperative Extension
College of Agriculture and Natural Resources
http://www.agnr.umd.edu/MCE/Publications/index.cfm

University of Massachusetts Extension
UMass Extension Bookstore
Draper Hall
40 Campus Center Way
Amherst, MA 01003-9244
Fax: 413-545-5174
E-mail: books@umext.umass.edu
http://www.umassextension.org/Merchant2/merchant.mv

Michigan State University Extension
108 Agriculture Hall
East Lansing, MI 48824-1039
Tel: 517-355-2308
Fax: 517-355-6473
E-mail: msue@msue.msu.edu
http://ceenet.msue.msu.edu/bulletin/ctlgmast.html

University of Minnesota Extension Service
Extension Distribution Center
405 Coffey Hall
420 Eckles Avenue
University of Minnesota
St. Paul, MN 55108-6068
Tel: 612-624-4900 or 800-876-8636
Fax: 612-625-6281
E-mail: order@extension.umn.edu
http://www.extension.umn.edu/units/dc/

Mississippi State University Extension Service
http://msucares.com/pubs/index.html

University of Missouri Outreach and Extension
E-mail: communicationse@umsystem.edu
http://muextension.missouri.edu/explore/

Montana State University Extension Service
Extension Publications
P.O. Box 172040
Montana State University
Bozeman, MT 59717-2040
Tel: 406-994-3273
E-mail: orderpubs@montana.edu
http://www.montana.edu/wwwpb/pubs/

University of Nebraska Cooperative Extension
Extension Publications
IANR Communications and Information Technology
Box 830918
Lincoln, NE 68583-0918
Fax: 402-472-0542
E-mail: tmcgill@unl.edu
http://www.ianr.unl.edu/pubs/browse.htm

University of Nevada Cooperative Extension
Tel: 775-784-7070
E-mail: gooda@unce.unr.edu
http://www.unce.unr.edu/pubs.html

University of New Hampshire Cooperative Extension
UNH Cooperative Extension Publication Center
Nesmith Hall, 131 Main Street
Durham, NH 03824-3597
Tel: 603-862-2346
Fax: 603-862-2441
E-Mail: ce.pubs@unh.edu
http://ceinfo.unh.edu/pubs.htm

Rutgers Cooperative Extension—New Jersey
Administrative office:
Rutgers Cooperative Extension
Cook College
Rutgers
88 Lipman Dr.
New Brunswick, NJ 08901-8525
Tel: 732-932-9306
http://www.rce.rutgers.edu/pubs/default.asp

New Mexico State University Cooperative Extension
Agricultural Communications—Bulletin Office
Box 30003, MSC 3AI
New Mexico State University
Las Cruces, NM 88003-8003
Tel: 505-646-2701
E-mail: bulletin@nmsu.edu
http://www.cahe.nmsu.edu/pubs/

Cornell Cooperative Extension—New York
Cornell University Resource Center
7 Business and Technology Park
Ithaca, NY 14850
Tel: 607-255-2080
Fax: 607-255-9946
E-mail: resctr@cornell.edu
http://www.cce.cornell.edu/publications/catalog.html

North Carolina State University Cooperative Extension
http://www.ces.ncsu.edu/resources/

North Dakota State University Extension Service
Distribution Center, NDSU Extension Service
Morrill Hall, P.O. Box 5655
North Dakota State University
Fargo, ND 58105-5655
Tel: 701-231-7882
Fax: 701-231-7044
E-mail: dctr@ndsuext.nodak.edu
http://www.ext.nodak.edu/extpubs/

Ohio State University Extension
Media Distribution
385 Kottman Hall
2021 Coffey Rd.
Columbus, Ohio 43210-1044
Tel: 614-292-1607
Fax: 614-292-1248
E-mail: pubs@ag.osu.edu
http://ohioline.osu.edu/lines/farm.html

Oklahoma State University Cooperative Extension Service
University Mailing Services
Oklahoma State University
Stillwater, OK 74078
Tel: 405-744-5385
http://pearl.agcomm.okstate.edu/

Oregon State University Extension
Publication Orders
Extension and Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
Fax: 541-737-0817)
E-mail: puborders@orst.edu
http://wwwagcomm.ads.orst.edu/agcomwebfile/EdMat/default.html

Penn State Cooperative Extension
Publications Distribution Center
The Pennsylvania State University
112 Agricultural Administration Building
University Park, PA 16802-2602
Tel: 814-865-6713
Fax: 814-863-5560
E-mail: AgPubsDist@psu.edu
http://pubs.cas.psu.edu/Subject.html

University of Rhode Island Cooperative Extension
Cooperative Extension Education Center
College of the Environment and Life Sciences
3 East Alumni Avenue
University of Rhode Island, Kingston, RI 02881
Tel: 401-874-2900
Fax: 401-874-2259
http://www.uri.edu/ce/factsheets/index.htm

Clemson University Cooperative Extension Service—South Carolina
Public Information Specialist
A-101 Poole Ag. Center
Clemson University
Clemson, S.C. 29634
Tel: 864-656-3876
Fax: 864-656-0742
E-Mail: sbeding@clemson.edu
http://www.clemson.edu/psapublishing/DIGITAL.HTM

South Dakota State University Cooperative Extension Service
http://agbiopubs.sdstate.edu/

Tennessee State University Cooperative Extension
http://www.tnstate.edu/cep/

University of Tennessee Agriculture Extension Service
Marketing and Communications Services
Institute of Agriculture
University of Tennessee
104 Morgan Hall
Knoxville, TN 37901-1071
Tel: 865-974-7141
Fax: 865-974-9433
http://www.utextension.utk.edu/

Texas A&M University Cooperative Extension
Distribution and Supply
P.O. Box 1209
Bryan, Texas 77806
Tel: 888-900-2577
Fax: 979-862-1566
E-mail: Texaserc@tamu.edu
http://tcebookstore.org/

Utah State University Cooperative Extension
Utah State University
Extension Bulletin Room #202
8960 Old Main Hill
Logan, UT 84322-8960
Tel: 435-797-2251
http://extension.usu.edu/cooperative/publications/?search=Extension%20Search

University of Vermont Extension
CTR: Publications
Agricultural Engineering Building
University of Vermont
Burlington, VT 05405-0004
http://www.uvm.edu/extension/publications/

Virginia Cooperative Extension
http://www.ext.vt.edu/resources/

Washington State University Cooperative Extension
Bulletin Office
Washington State University
Box 645912
Pullman, WA 99164-5912
Tel: 509-335-2857
http://pubs.wsu.edu/cgi-bin/pubs/index.html

West Virginia University Extension Service
Offices of Communications and Technology.
West Virginia University Extension Service
507 Knapp Hall
Morgantown, WV 26506-6031
Tel: 304-293-4221
Fax: 304-293-6611
http://www.wvu.edu/~exten/infores/pubs.htm

University of Wisconsin Extension
Cooperative Extension Publications
45 North Charter Street
Madison, WI 53715
Tel: 608-262-3346
Fax: 608-265-8052
E-mail: breitzman@admin.uwex.edu
http://www1.uwex.edu/ces/pubs/

University of Wyoming Cooperative Extension Service
University of Wyoming
Cooperative Extension Service
P.O. Box 3354
Laramie, WY 82071-3354
http://www.uwyo.edu/ces/pubs3.htm

University of the Virgin Islands
Cooperative Extension
Clarice Clarke, St. Croix
Extension Specialist, Communications
Tel: 340-692-4060
E-mail: cclarke@uvi.edu
http://rps.uvi.edu/CES/comhome.htm

University of Guam Cooperative Extension
Victor T. Artero, Associate Dean/Director
CES
CALS Building, Room 206
UOG Station, Mangilao GU 96923
E-mail: vartero@uog9.uog.edu
http://www.uog.edu/cals/site/publications.html

Endnotes

[1] A brief description of *NCAT's Organic Livestock Workbook* can be found at <http://attra.ncat.org/attra-pub/livestockworkbooksum.html>. The full document can be downloaded in PDF format at <http://attra.ncat.org/attra-pub/PDF/livestockworkbook.pdf>. A hardcopy may be requested by calling ATTRA at 1-800-346-9140.

[2] For information on the Independent Organic Inspectors Association, contact IOIA, P.O. Box 6, Broadus, MT 59317, Tel: 406-436-2031, Website: <http://www.ioia.net/>.

[3] *NCAT'S Organic Crops Workbook* can be downloaded in PDF format at <http://attra.ncat.org/attra-pub/PDF/cropsworkbook.pdf>.

[4] The 1990 Asilomar Declaration states that "[a] sustainable agriculture provides nourishing food, protects those who work the land, helps stabilize the earth's climate, and safeguards soil and water." The American Society of Agronomy's definition says that "[a] sustainable agriculture is one that, over the long term, enhances the environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable; and enhances the quality of life for farmers and society as a whole."

[5] You may also wish to use the *National Organic Program Compliance Checklist for Producers*, available from ATTRA at <http://attra.ncat.org/attra-pub/PDF/compliance.pdf>.

[6] *Humus* refers to the relatively stable state that organic plant and animal materials achieve following decomposition in the soil or compost pile.

[7] For more information on the history of organic farming, see ATTRA's *Overview of Organic Crop Production* at <http://attra.ncat.org/attra-pub/organiccrop.html>. To access some of the classic texts on humus farming visit the Soil and Health Library website at <http://www.soilandhealth.org>.

[8] OFPA text can be found on the National Organic Program website at <http://www.ams.usda.gov/nop/archive/OFPA.html>.

[9] For more information on federal regulation of organic farming, visit the website of the National Organic Program at <http://www.ams.usda.gov/nop/>. Additional useful information can be accessed on the Organic Trade Association website specifically at <http://www.ota.com/organic/us_standards.html>. Also see ATTRA's *Organic Farm Certification & The National Organic Program* at <http://attra.ncat.org/attra-pub/organcert.html>.

[10] A list of accredited certifiers can be found on the National Organic Program website at <http://www.ams.usda.gov/nop/CertifyingAgents/Accredited.html>.

[11] A sample of a Purchased or Rented Land Verification Form is provided as a template on the Minnesota Department of Agriculture website at <http://www.mda.state.mn.us/esap/organic/sampleforms.pdf>.

[12] A discussion of this subject can be found on the OTA website at <http://www.ota.com/NewYorkTimesJuly16.html>.

[13] The easiest way to access the National Organic Standard is to visit the NOP's website at <http://www.ams.usda.gov/nop/NOP/standards.html>.

[14] ATTRA has generic OSP forms available in the publication *Creating an Organic Production and Handling System Plan: A Guide to Organic Plan Templates* at <http://attra.ncat.org/attra-pub/handlingsys.html>.
[15] A sample map is provided on the Minnesota Department of Agriculture website at <http://www.mda.state.mn.us/esap/organic/sampleforms.pdf>.
[16] ATTRA maintains a current listing of sources for such signs. Request the publication *Sources of "Spraying Prohibited" Signs for Organic Farms* or download from <http://attra.ncat.org/attra-pub/sprayingpro.html>.
[17] A sample of a neighbor notification letter is provided in template form on the Minnesota Department of Agriculture website at: <http://www.mda.state.mn.us/esap/organic/sampleforms.pdf>.
[18] A sample of an adjoining land use verification form is provided as a template on the Minnesota Department of Agriculture website at: <http://www.mda.state.mn.us/esap/organic/sampleforms.pdf>.
[19] Guidelines are provided in the Minnesota Department of Agriculture Factsheet *Pesticide Drift and Misuse* at <http://www.mda.state.mn.us/appd/pesticides/drift.pdf>.
[20] For an interesting article on farm biodiversity, see "Farming with the Wild: Agriculture and the Biodiversity Crisis" in *Biodiversity*, Vol. 11, No. 1. (Winter 2001) at <http://www.cgbd.org/visitor/publications/biodiversity_winter01.pdf>.
[21] A suggested source for information on crop rotation is *Principles and Practices of Crop Rotation*, <http://www.agr.gov.sk.ca/docs/crops/integrated_pest_management/soil_fertility_fertilizers/cpc0397.asp>, from Saskatchewan. Also recommended is SAN's publication, *Managing Cover Crops Profitably, 2nd edition* <http://www.sare.org/handbook/mccp2/index.htm>.
[22] A suggested source of information on cover crops is ATTRA's *Overview of Cover Crops and Green Manures*, at <http://attra.ncat.org/attra-pub/covercrop.html>. Also recommended is SAN's *Managing Cover Crops Profitably, 2nd edition* at <http://www.sare.org/handbook/mccp2/index.htm> and Ohio State's publication AGF-142-99 *Cover Crop Fundamentals* at <http://ohioline.osu.edu/agf-fact/0142.html>.
[23] See the ATTRA publication *Intercropping Principles and Practices* at <http://attra.ncat.org/attra-pub/intercrop.html>.
[24] See the ATTRA publication *Companion Planting: Basic Concept and Resources* at <http://attra.ncat.org/attra-pub/complant.html>.
[25] See the ATTRA publication *AgroforestryOverview* at <http://attra.ncat.org/attra-pub/agroforestry.html>.
[26] For information on how non-crop areas can be used to promote beneficial insects and other organisms, and natural pest control, see ATTRA's *Farmscaping to Enhance Biological Control* at <http://attra.ncat.org/attra-pub/farmscape.html>.
[27] For more information, refer to *NCAT's Organic Livestock Workbook*, the companion to this document, at <http://attra.ncat.org/attra-pub/livestockworkbooksum.html>.
[28] This example is cited in Eliot Coleman's *The New Organic Grower* – an excellent guide for market farming. It can be ordered from Acres USA (See Resources Section).
[29] The discussion provided here is brief and does not make clear how fundamentally important soil management is to a working organic system. There are many excellent books on the subject, but to get a good perspective, see ATTRA's *Sustainable Soil Management* at <http://attra.ncat.org/attra-pub/soilmgmt.html> and the University of California's *Soil Management and Soil Quality for Organic Crops* at <http://anrcatalog.ucdavis.edu/pdf/7248.pdf> and *Soil Fertility Management for Organic Crops* at <http://anrcatalog.ucdavis.edu/pdf/7249.pdf>.
[30] For more information on soil testing, see ATTRA's publication *Sustainable Soil Management* at <http://attra.ncat.org/attra-pub/soilmgmt.html>. A number of commercial soil testing laboratories provide organic fertilizer recommendations. See ATTRA's *Alternative Soil Testing Laboratories* at <http://attra.ncat.org/attra-pub/soil-lab.html>. The University of Georgia's *How to Convert an Inorganic Fertilizer Recommendation to an Organic One* at <http://www.ces.uga.edu/pubcd/C853.htm> may also be helpful.
[31] §205.203(c) of the NOP Standard states that producers must maintain or improve "soil organic matter content." In most instances where this publication makes reference to soil organic matter, we have chosen to use the term *humus*. *Humus* refers to the relatively stable state that organic plant and animal mate-

rials achieve following decomposition in the soil or compost pile. Monitoring humus rather than total organic matter is more effective in assessing the quality and fertility of soil.

[32] See the ATTRA publication *Pursuing Conservation Tillage Systems for Organic Crop Production* at <http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html>.

[33] A suggested source of information on green manures is ATTRA's *Overview of Cover Crops and Green Manures*, which can be found at <http://www.attra.org/attra-pub/covercrop.html>. Also recommended is SAN's *Managing Cover Crops Profitably, 2nd edition* <http://www.sare.org/handbook/mccp2/index.htm>.

[34] For practical information on composting, ask for ATTRA's *Farm-Scale Composting Resource List* <http://attra.ncat.org/attra-pub/farmcompost.html>. Also see the University of Missouri publication G6956 *Making and Using Compost* at <http://muextension.missouri.edu/xplor/agguides/hort/g06956.htm>, the University of Maine Cooperative Extension Bulletin #1159 *How Compost Happens* at <http://www.umext.maine.edu/onlinepubs/htmpubs/1159.htm>, and Louisiana State's *Basic Principles of Composting* at <http://www.lsuagcenter.com/Communications/pdfs_bak/compost.PDF>.

[35] See ATTRA's *Manures for Organic Crop Production* at <http://attra.ncat.org/attra-pub/manures.html>.

[36] For more information on rotational grazing, see the ATTRA publications *Sustainable Pasture Management* at <http://attra.ncat.org/attra-pub/sustpast.html>, *Rotational Grazing* at <http://attra.ncat.org/attra-pub/rotategr.html>, *Matching Livestock and Forage Resources in Controlled Grazing* at <http://attra.ncat.org/attra-pub/matchlandf.html>, and *Introduction to Paddock Design and Fencing—Water Systems for Controlled Grazing* at <http://attra.ncat.org/attra-pub/paddock.html>.

[37] ATTRA is developing further information on a number of esoteric practices. Currently available is ATTRA's *Biodynamic Farming & Compost Preparation* at <http://attra.ncat.org/attra-pub/biodynamic.html>. For information on radionics, see *Radionics in Agriculture* at <http://home.earthlink.net/~gkuepper/index/Radionics.htm>. For in-depth reading on a wide range of esoteric agricultural practices, see the books *Secrets of the Soil* and *Stone Age Farming*, available from Acres, USA.

[38] See literature cited on cover crops. Also useful is Oregon State's publication EM8728 *Nitrogen Scavenging…* at <http://eesc.orst.edu/agcomwebfile/edmat/html/em/em8728/em8728.html>.

[39] For information on organic fertilizer materials, see ATTRA's *Alternative Soil Amendments* publication at <http://attra.ncat.org/attra-pub/altsoilamend.html>. For sources, see ATTRA's *Sources for Organic Fertilizers & Amendments* at <http://attra.ncat.org/attra-pub/orgfert.html>.

[40] See ATTRA's *Foliar Fertilization* at <http://attra.ncat.org/attra-pub/PDF/foliar.pdf>.

[41] Many state extension offices have lists of organic fertilizers and amendments featuring their N-P-K values and other information. Two good on-line sources are North Carolina's *Nutrient Content of Fertilizer and Organic Materials* at <http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-18/> and Cornell University's *A Guide to the Nutrient Value of Organic Materials* at <http://www.cce.cornell.edu/counties/Suffolk/grownet/organic/nutrient.html>.

[42] The University of Connecticut's website features a publication entitled *Using Wood Ashes in the Garden*. Look for it using the search feature at <http://www.hort.uconn.edu/ipm/>. Also, the University of Maine's publication #2279 *Using Wood Ash on your Farm* can be ordered from their website. See <http://www.umext.maine.edu/publications/crops.htm>.

[43] Contact information for OMRI can be found in the Resources Section of this workbook.

[44] For further information, see ATTRA's *Protecting Water Quality on Organic Farms* at <http://attra.ncat.org/attra-pub/organicmatters/om-waterquality.html>.

[45] For good general information on organic weed management see the University of California's *Weed Management for Organic Crops* at <http://anrcatalog.ucdavis.edu/pdf/7250.pdf> and Saskatchewan's *Organic Crop Production: Weed Management* at <http://www.agr.gov.sk.ca/docs/organics/research/OrganicWeed_Spoke03..pdf>.

[46] For more information see Charles Walter's *Weeds, Control Without Poisons* (Acres USA), Ehrenfried Pfeiffer's *Weeds and What They Tell* (Acres, USA), ATTRA's *Principles of Sustainable Weed Management* at <http://attra.ncat.org/attra-pub/weed.html>, and SAN's *A Whole-Farm Approach to Managing Pests* at <http://www.sare.org/bulletin/farmpest/>.

[47] For more information on conservation tillage, see ATTRA's *Pursuing Conservation Tillage Systems for Organic Crop Production* at <http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html>.
[48] See ATTRA's *Pursuing Conservation Tillage Systems for Organic Crop Production* at <http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html>.
[49] See ATTRA's *Pursuing Conservation Tillage Systems for Organic Crop Production* at <http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html>.
[50] For more information, see the cover crop literature already cited.
[51] ATTRA has further information available on weeder geese.
[52] For additional information on mulching, see the University of Illinois publication NRES-19-97 *Organic Mulch* at <http://www.ag.uiuc.edu/%7Evista/html_pubs/mulch/MULCH.html> and the University of Georgia publication *Mulching Vegetables* at <http://www.ces.uga.edu/Agriculture/horticulture/veg-mulch.html>.
[53] For information on cultivation tools and techniques, Greg Bowman's *Steel In The Field: A Farmer's Guide to Weed Management Tools* (Sustainable Agriculture Network) is recommended. Also see Iowa State's on-line publication *Cultivation: An Effective Weed Management Tool* at <http://www.extension.iastate.edu/Publications/PM1623.pdf>.
[54] See Oklahoma State's Extension fact sheet F-7640, *Solar Heating (Solarization) of Soil in Garden Plots for Control of Soilborne Plant Diseases* <http://pearl.agcomm.okstate.edu/plantdiseases/f-7640.pdf>.
[55] ATTRA has two publications: *Flame Weeding for Vegetable Crops* at <http://attra.ncat.org/attra-pub/flameweedveg.html>, and *Flame Weeding for Agronomic Crops* at <http://attra.ncat.org/attra-pub/flameweed.html>.
[56] For good general information on organic pest and disease management, see the University of California publications *Plant Disease Management for Organic Crops* at <http://anrcatalog.ucdavis.edu/pdf/7252.pdf> and *Insect Pest Management for Organic Crops* at <http://anrcatalog.ucdavis.edu/pdf/7251.pdf> and Saskatchewan's publications *Organic Crop Management: Insect Management* at <http://www.agr.gov.sk.ca/docs/organics/research/organicinsect.asp?firstPick=Organics&secondpick=Production%20Information&thirdpick=Null> and *Organic Crop Management: Disease Management* at: <http://www.agr.gov.sk.ca/docs/organics/research/organicdisease.asp?firstPick=Organics&secondpick=Production%20Information&thirdpick=Null>.
[57] See ATTRA's *Organic Sweet Corn Production* at <http://attra.ncat.org/attra-pub/sweetcorn.html>.
[58] See ATTRA's *Considerations in Organic Apple Production* at <http://attra.ncat.org/attra-pub/PDF/omapple.pdf>.
[59] See ATTRA's *Companion Planting* at <http://attra.ncat.org/attra-pub/complant.html>.
[60] See ATTRA's *Intercropping Principles and Practices*, at <http://attra.ncat.org/attra-pub/intercrop.html>.
[61] See the cover crop literature previously cited.
[62] For information on agronomic crop rotations for pest control, see North Dakota State's publication PP-705 *Crop Rotations for Managing Plant Disease* at <http://www.ext.nodak.edu/extpubs/plantsci/pests/pp705w.htm> and University of Nebraska's publication EC95-1560-B *Use of Cultural Practices in Crop Insect Pest Management* at <http://www.ianr.unl.edu/pubs/insects/ec1560.htm>. For information on vegetable crop rotations, see the University of Delaware publication PP-27 *Rotation Periods to Control Vegetable Diseases* at <http://ag.udel.edu/extension/information/pp/pp-27.htm> and Mississippi State's *Organic Vegetable IPM Guide* at <http://msucares.com/pubs/publications/pub2036.htm>.
[63] For information on how to promote beneficial insects and natural pest control, see ATTRA's *Farmscaping to Enhance Biological Control* at <http://attra.ncat.org/attra-pub/farmscape.html>.
[64] For sources of beneficial insects see Ohio State's *Commercial Suppliers of Beneficial Organisms* at <http://ohioline.osu.edu/hyg-fact/2000/2122.html>and University of Tennessee's *Commercial Source of Predators, Parasitoids, and Pathogens* at <http://www.utextension.utk.edu/publications/spfiles/sp290z.pdf>.

[65] See ATTRA's *Biointensive Integrated Pest Management* at <http://attra.ncat.org/attra-pub/ipm.html> and SAN's *A Whole-Farm Approach to Managing Pests* at <http://www.sare.org/bulletin/farmpest/>. Also useful is Ohio State's publication HYG-1033-98 *Sticky Traps: A Useful Tool for Pest-Scouting Programs* at <http://ohioline.osu.edu/hyg-fact/1000/1033.html>. Most Cooperative Extension offices have information on IPM.

[66] See ATTRA's *Organic Control of Squash Bug* at <http://attra.ncat.org/attra-pub/squashbug.html>.

[67] Contact Cooperative Extension for information on adapted varieties with bred-in resistance to diseases and insect pests.

[68] For sanitation procedures for vegetable production see Mississippi State's *Organic Vegetable IPM Guide* at <http://msucares.com/pubs/publications/pub2036.htm>. For fruit production, see the University of Illinois's *Cultural Practices to Control Diseases in Home Fruit Plantings* at <http://web.aces.uiuc.edu/vista/pdf_pubs/807.pdf>.

[69] An example of trap cropping for brassica crops is provided in the University of Connecticut publication *Perimeter Trap Cropping for Cole Crops.* To locate this publication, click on "Vegetable IPM" at the University of Connecticut IPM website at <http://www.hort.uconn.edu/ipm>.

[70] For information on row covers, including a list of commercial sources, see the ATTRA's *Season Extension Techniques for Market Gardeners* at <http://attra.ncat.org/attra-pub/seasonext.html>. For more information on row covers as pest barriers, see Cornell University's *Insect Traps and Barriers* at <http://www.cce.cornell.edu/counties/Suffolk/grownet/organic/barriers.htm>.

[71] See Cornell University's *Insect Traps and Barriers* at <http://www.cce.cornell.edu/counties/Suffolk/grownet/organic/barriers.htm> and Ohio State's publication HYG-1033-98 *Sticky Traps: A Useful Tool for Pest-Scouting Programs* at <http://ohioline.osu.edu/hyg-fact/1000/1033.html>.

[72] For examples of tillage use for pest management in agronomic crops, see the University of Nebraska's publication EC95-1560-B *Use of Cultural Practices in Crop Insect Pest Management* at <http://www.ianr.unl.edu/pubs/insects/ec1560.htm>. For examples of tillage in vegetable crops, see Mississippi State's *Organic Vegetable IPM Guide* at <http://msucares.com/pubs/publications/pub2036.htm>.

[73] See ATTRA's *Organic Alfalfa Production* at <http://attra.ncat.org/attra-pub/alfalfa.html>.

[74] See ATTRA's *Colorado Potato Beetle: Organic Control Options* at <http://attra.ncat.org/attra-pub/coloradopotato.html>.

[75]See ATTRA's *"Bug Vacuums" for Organic Crop Protection* at <http://attra.ncat.org/attra-pub/bugvacuums.html>.

[76] Several good general resources on organic pest control agents are available. Among them are University of Connecticut's *Pesticides for Organic Growers* (use the searchable feature at the University's website <http://www.hort.uconn.edu/ipm>), New Mexico State's publication H-150 *Organic Gardening—Natural Insecticides* at <http://www.cahe.nmsu.edu/pubs/_h/h-150.html>, and Mississippi State's *Organic Vegetable IPM Guide* at <http://msucares.com/pubs/publications/pub2036.htm>. Also worth reading is the University of Connecticut's *Ignoring Labels on Organic Products Can Cause Problems.* Use the search feature at <http://www.hort.uconn.edu/ipm>. Remember these publications may feature materials and recommendations that are not consistent with the National Organic Standard.

[77] See Oklahoma State's publication F-7307 *Beneficial Insects* at <http://pearl.agcomm.okstate.edu/insects/home/f-7307.pdf> and Purdue University's *Common Natural Enemies* at <http://www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-92.pdf>. For sources of beneficial insects, see the endnote on question 8.2 "Release of beneficial insects".

[78] Appendix B of ATTRA's *Biointensive Integrated Pest Management* at <http://attra.ncat.org/attra-pub/ipm.html> features a list of microbial pesticides, tradenames, and suppliers. Most of these are allowed in certified organic production.

[79] See Iowa State's *Botanical Pesticides in the Home Garden* at <http://www.extension.iastate.edu/Publications/RG208.pdf>, New York State's *Nature's Botanical Insecticide Arsenal* at: <http://www.hort.cornell.edu/gardening/fctsheet/egfactsh/botanica.html>, and Oklahoma State's publication F-6433 *Botanical Pest Controls* at <http://pearl.agcomm.okstate.edu/hort/ornamental/f6433.htm>. Caution: not all recommendations in these publications will be consistent with the Organic Standard. Use them as supplementary information only.

[80] See North Carolina State's *Horticultural Oils as Insecticides* at <http://www.ces.ncsu.edu/depts/ent/notes/Other/not45.html>, Texas A & M University's *Horticultural Oils and Pest Control* at <http://tcebookstore.org/tmppdfs/739220-L5350.pdf >, and the University of Connecticut's *Horticultural Oils*, which can be located using the search feature at <http://www.hort.uconn.edu/ipm/>.

[81] See the University of Connecticut's *Insecticidal Soaps*. To locate this publication, use the search feature at their IPM website at <http://www.hort.uconn.edu/ipm>.

[82] Useful publications include ATTRA's *Insect IPM in Apples: Kaolin Clay* at <http://attra.ncat.org/attra-pub/PDF/kaolin-clay-apples.pdf>, ATTRA's *Use of Baking Soda as a Fungicide* at <http://attra.ncat.org/attra-pub/bakingsoda.html>, the University of California's *Bordeaux Mixture* at <http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7481.html>, the University of Wyoming's *Bordeaux Mixture Fungicide Preparation*, which may be ordered from their publications catalogue at <http://www.uwyo.edu/ces/PUBS/Mp7r2002.PDF>, and McGill University's *Diatomaceous Earth: A Nontoxic Pesticide* at <http://www.eap.mcgill.ca/Publications/eap4.htm>.

[83] See the University of Connecticut's *Neem Based Insecticides*. To locate this publication, use the search feature at their IPM website at <http://www.hort.uconn.edu/ipm>.

[84] There are various formulations of "Bt", all of which control the immature stages of insect pests. Commercial products are now available to control moth and butterfly pest larvae, Colorado potato beetle larvae, and mosquito and black fly larvae. For more information, see Colorado State publication no. 5.556 on *Bacillus thuringiensis* at <http://www.ext.colostate.edu/pubs/insect/05556.html>.

[85] *Beauveria bassiana* has a fungus as its active agent. For more information, see the University of Connecticut's searchable IPM website at <http://www.hort.uconn.edu/ipm> and follow the "Vegetable IPM" link for *Using Beauveria bassiana for Insect Management*.

[86] Trichoderma harzianum is a fungal agent that works to control soil diseases. See the University of Connecticut's *Trichoderma for Control of Soil Pathogens*. To locate this publication, click on the "Vegetable IPM" link at the University of Connecticut IPM website at <http://www.hort.uconn.edu/ipm>.

[87] Spinosads are a relatively new class of biological insecticides derived from a rare form of soil-dwelling actinomycete. Spinosads control a variety of insect pests, including thrips, fruitflies, and caterpillars. Like other biologicals, they are reported to have limited negative effects on beneficial insects. Some current product names include Conserve® and Entrust®.

[88] *Phytotoxic* is a fancy term meaning that the plant can be harmed.

[89] Instructions for making and using a simple homemade penetrometer can be found in ATTRA's *Assessing the Pasture Soil Resource*, at <http://attra.ncat.org/attra-pub/pastsoil.html>.

[90] See ATTRA's *Dung Beetle Benefits in the Pasture Ecosystem* at <http://attra.ncat.org/attra-pub/dungbeetle.html>.

[91] See ATTRA's *Manures for Organic Crop Production* at <http://attra.ncat.org/attra-pub/manures.html>; this publication also contains information on spreader calibration. Also see the University of Minnesota's *Estimating Manures' Fertilizer Replacement Value* at <http://www.extension.umn.edu/distribution/livestocksystems/DI7197.html> and Oregon State's publication EC1094 *Calculating the Fertilizer Value of Manure from Livestock Operations* at <http://eesc.orst.edu/agcomwebfile/EdMat/html/EC/EC1094/EC1094.html>. For producers having access to manures from zoo and circus animals, the University of Illinois publication *Circus Animal Manure* at <http://www.solutions.uiuc.edu/content.cfm?item=558&series=4> may be helpful.

[92] Information on calibration is provided in ATTRA's *Manures for Organic Crop Production* at <http://attra.ncat.org/attra-pub/manures.html>.
[93] See Ohio State's *Best Management Practices: Application of Organic Materials on Soils Used for Crop Production* at <http://ohioline.osu.edu/agf-fact/0211.html>.
[94] For practical information on composting, see ATTRA's *Farm-Scale Composting Resource List* <http://attra.ncat.org/attra-pub/farmcompost.html>. Also see the University of Missouri publication G6956 *Making and Using Compost* at <http://muextension.missouri.edu/xplor/agguides/hort/g06956.htm>, the University of Maine Cooperative Extension Bulletin #1159 *How Compost Happens* at <http://www.umext.maine.edu/onlinepubs/htmpubs/1159.htm>, and Louisiana State's *Basic Principles of Composting* at <http://www.lsuagcenter.com/Communications/pdfs_bak/pub2622compost.PDF>.
[95] You can find the EPA guidelines at <http://www.epa.gov/epaoswer/non-hw/compost/biosolid.pdf>.
[96] Information on production of compost teas is available in ATTRA's *Compost Teas for Plant Disease Control* at <http://attra.ncat.org/attra-pub/comptea.html>. Soil Food Web, Inc. has produced a manual for the production of compost teas entitled *The Compost Tea Manual, 3rd Edition* by Dr. Elaine Ingham. Details can be found at <http://www.soilfoodweb.com/phpweb/userpage.php?op=view&uid=217>.
[97] See ATTRA's *Worms for Composting (Vermicomposting)* publication at <http://attra.ncat.org/attra-pub/vermicom.html>.
[98] See Ohio State's *Best Management Practices: Application of Organic Materials on Soils Used for Crop Production* at <http://ohioline.osu.edu/agf-fact/0211.html>.
[99]See The Kerr Center for Sustainable Agriculture's *Riparian Area Management Techniques* at <http://www.kerrcenter.com/kerrweb/riparian/riparian.pdf>.
[100] For assistance in locating sources of organic seeds and planting stock, see ATTRA's *Suppliers of Seed for Certified Organic Production (Including Untreated and Non-GMO Seed)* at <http://attra.ncat.org/attra-pub/altseed.html>. OMRI is developing a listing of certified organic seed and planting stock producers. See the *OMRI Seed and Planting Stock List* at <http://www.omri.org/OMRI_SEED_list.html>.
[101] Useful resources include ATTRA's *Organic Potting Mixes for Certified Production* at <http://attra.ncat.org/attra-pub/potmix.html> and *Organic Plug and Transplant Production* at <http://attra.ncat.org/attra-pub/plugs.html>.
[102] ATTRA has a number of publications to assist in organic greenhouse production and pest management including: *Organic Greenhouse Vegetable Production* at <http://attra.ncat.org/attra-pub/ghveg.html>, *Organic Greenhouse Herb Production* at <http://attra.ncat.org/attra-pub/gh-herbhold.html>, *Integrated Pest Management for Greenhouse Crops* at <http://attra.ncat.org/attra-pub/gh-ipm.html>, *Greenhouse IPM: Sustainable Aphid Control* at <http://attra.ncat.org/attra-pub/gh-aphid.html>, *Greenhouse IPM: Sustainable Thrips Control* at <http://attra.ncat.org/attra-pub/gh-thrips.html>, and *Greenhouse IPM: Sustainable Whitefly Control* at <http://attra.ncat.org/attra-pub/gh-whitefly.html>.
[103] See ATTRA's *Organic Potting Mixes for Certified Production* at <http://attra.ncat.org/attra-pub/potmix.html>.
[104] For more information, see Ohio State's publication HYG-1033-98 *Sticky Traps: A Useful Tool for Pest-Scouting Programs* at <http://ohioline.osu.edu/hyg-fact/1000/1033.html>, and Cornell University's publication *Insect Traps and Barriers* at <http://www.cce.cornell.edu/counties/Suffolk/grownet/organic/barriers.htm>.
[105] See ATTRA's *Organic Alternatives to Treated Lumber* at <http://attra.ncat.org/attra-pub/lumber.html>.
[106] ATTRA has information prepared on natural pest control alternatives for grain storage in *Stored Grain Pest Management* at <http://attra.ncat.org/attra-pub/storedgrain.html>.
[107] See ATTRA's *Post-Harvest Handling of Fruits and Vegetables* at <http://attra.ncat.org/attra-pub/postharvest.html> and the University of California's *Post-Harvest Handling for Organic Crops* at <http://anrcatalog.ucdavis.edu/pdf/7254.pdf>
[108] ATTRA has generic Organic System Plan forms available in the publication *Creating an Organic Production and Handling System Plan: A Guide to Organic Plan Templates* at <http://attra.ncat.org/attra-pub/handlingsys.html>. A portion of the publication includes templates for organic handling systems.

[109] A sample of a clean truck affidavit is provided in template form on the Minnesota Department of Agriculture website at <http://www.mda.state.mn.us/esap/organic/sampleforms.pdf>.
[110] ATTRA's publication *Organic Marketing Resources* <http://attra.ncat.org/attra-pub/markres.html> is recommended reading for those exploring organic marketing options. Also recommended is the SAN publication *Reap New Profits: Marketing Strategies for Farmers and Ranchers* <http://www.sare.org/market99/index.htm>.
[111] See ATTRA's *Community Supported Agriculture* at <http://attra.ncat.org/attra-pub/csa.html>.
[112] See ATTRA's *Direct Marketing* at <http://attra.ncat.org/attra-pub/directmkt.html>.
[113] See ATTRA's *Farmers' Markets* at <http://attra.ncat.org/attra-pub/farmmrkt.html>.
[114] The ATTRA publications *Direct Marketing* at <http://attra.ncat.org/attra-pub/directmkt.html> and *Entertainment Farming & Agri-Tourism* at <http://attra.ncat.org/attra-pub/entertainment.html> have information on roadside sales. In addition, Cornell University has building plans and other information available in *Facilities for Roadside Markets*, available from their on-line catalogue at <http://www.cce.cornell.edu/publications/agriculture.cfm>.
[115] See ATTRA's *Entertainment Farming & Agri-Tourism* at <http://attra.ncat.org/attra-pub/entertainment.html>.
[116] In the Julian Date Calendar, each day is assigned a number in sequence from 001 through 365 (366 in leap years). The Julian system is commonly used for product coding. An example of the Julian calendar is featured at <http://www.dscr.dla.mil/sbo1/julian_date_calendar.htm>.
[117] ATTRA has several packages of documentation forms that can be useful. See <http://attra.ncat.org/attra-pub/PDF/cropforms.pdf> for *Organic Field Crops Documentation Forms*, and *Organic Orchard, Vineyard, and Berry Crop Documentation Forms* at <http://attra.ncat.org/attra-pub/PDF/orchardforms.pdf>. Livestock producers may wish to utilize *Organic Livestock Documentation Forms* at <http://attra.ncat.org/attra-pub/PDF/livestockforms.pdf>.
[118] A sample of a complaint log is provided as a template on the Minnesota Department of Agriculture website at: <http://www.mda.state.mn.us/esap/organic/sampleforms.pdf>.