FUNDAMENTALS OF

Organic Agriculture

The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals, and people.

What Is Organic Agriculture?

According to the National Organic Standards Board (NOSB) of the United States Department of Agriculture (USDA), organic agriculture is "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, or enhance ecological harmony. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals, and people." (NOSB, 2003)

Though the term "organic" is defined by law (see "Legal" section on pages 3 and 4), the terms "natural" and "eco-friendly" are not. Labels that contain those terms may imply some organic methods were used in the production of the foodstuff but do not guarantee complete adherence to organic practices as defined by a law. Some products marketed as "natural" may have been produced with synthetic or manufactured products (those not considered to be "organic"), such as "natural beef." While eco-labels are encouraged for producers interested in lowering synthetic inputs and farming with ecological principles in mind (biodiversity, soil quality, biological pest control), eco-labels are not regulated as strictly as USDA organic labels.

Products labeled as "organic" meet strict legal requirements, including certification by a third party.

IOWA STATE UNIVERSITY
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PM 1880 May 2003

Organic Agriculture

History

Organic agriculture is the oldest form of agriculture on earth. Farming without the use of petroleum-based chemicals (fertilizers and pesticides) was the sole option for farmers until after World War II. The war brought with it technologies that were useful to agricultural production. For example, ammonium nitrate used for munitions during World War II evolved into ammonium nitrate fertilizer; organophosphate nerve gas production led to the development of powerful insecticides. These technical advances since World War II have resulted in significant economic benefits as well as environmental and social detriments. Organic agriculture seeks to use those advances that consistently yield benefits, such as new varieties of crops, precision agriculture technologies, and more efficient machinery, while discarding those methods that have led to negative impacts on society and the environment, such as pesticide pollution and insect pest resistance. Organic farming is considered a systems approach, where interactions between components (crops, animals, insects, soil) are as important as the whole farm itself.

Instead of using synthetic fertilizers, organic farmers use crop rotations, cover crops, and compost to maintain or enhance soil fertility. Also, instead of using synthetic pesticides, organic farmers employ biological, cultural, and physical methods to limit pest expansion and increase populations of beneficial insects. Genetically-modified organisms (GMOs), such as herbicide-resistant seeds and plants, as well as product ingredients, such as GM-lecithin, are disallowed in organic agriculture because they constitute synthetic inputs and pose unknown risks (see GMO discussion opposite).

In 2001, there were 2.3 million acres in organic production in the United States.

. . . the largest purchasers of organic products are young people and college-educated consumers.

U.S. Statistics

The USDA reported on organic production statistics in the United States (USDA-ERS, 2002). This census, conducted in 2002, identified U.S. farmers who reported 2.5 million acres of land dedicated to organic production. This figure probably under-represents current production because many organic farmers produce their products organically, but sell less than $15,000 per year and are exempt from inspection (see "Organic Certification"), or do not label their product as organic and, in general, are direct marketing to a local customer. In 1999, Iowa farmers reported 150,000 acres of organic cropland to the Iowa Department of Agriculture and Land Stewardship (IDALS) survey. This increase in organic acreage in Iowa represents a doubling from the previous year and a sixfold increase since 1996.

The U.S. organic industry continues to grow at a rate of 20 percent annually. Industry estimates placed it at $10 billion in 2001. The organic industry is a consumer-driven market. According to industry surveys, the largest purchasers of organic products are young people and college-educated consumers. Today we are faced with the unique opportunity to take advantage of a growing market demand and use the technologies developed over the past 50 years. More and more farmers are interested in the profitability and environmental benefits that organic systems yield.

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World Statistics

Worldwide consumption of organic products has experienced tremendous growth, often surpassing the U.S. figures of 20 percent annual gain. Much of the increase in worldwide consumption has been fueled by consumers' demand for GMO-free products. Because GMOs are disallowed in organic production and processing, organic products automatically are designated as GMO-free at the marketplace. European consumers have led the demand for organic products, particularly in countries such as the Netherlands, Italy, and Austria. Two percent of all German farmland, four percent of Italian farmland, and 10 percent of Austrian farmland is managed organically. Prince Charles of England has developed a model organic farm and has established a system of government support for farmers making the transition to organic production. Major supermarket chains and restaurants in Europe and the United States offer a wide variety of organic products in their aisles and on their menus.

Organic produce has become a more visible menu item at restaurants around the world.

Philosophy

The motivations for organic production include concerns about the economy, the environment, and food safety. Although all organic farmers avoid synthetic chemicals in their operations, they differ in how they achieve the ideal system. Organic farmers span the spectrum: some completely eschew external inputs and create on-farm sources of compost for fertilization and encourage the activity of beneficial insects through conservation of food and nesting sites. Others import their fertility and pest management inputs. The philosophy of "input substitution" is discredited by many longtime advocates of organic agriculture. A truly sustainable method of organic farming would seek to eliminate, as much as possible, reliance on external inputs.

The motivations for organic production include concerns about the economy, the environment, and food safety.

Organic Certification—Legalities and Logistics

When Congress passed the Organic Food Production Act (OFPA) in 1990, it was heralded by many as the first U.S. law to regulate a system of farming. This law can be accessed at the Web site http://www.ams.usda.gov/nop/. OFPA requires that anyone selling products as "organic" must follow a set of prescribed practices that includes avoiding synthetic chemicals in crop and livestock production and in the manufacturing of processed products. Organic certification agencies were established in the United States to provide the required third-party certification. Some states, including Iowa, followed suit and established their own organic laws. In 1990 Iowa passed Chapter 190,

adopting the definition of organic as prescribed in OFPA and establishing penalties for producers falsely identifying their products as organic. Iowa allows private certification agencies to operate in addition to its own certification program. This system is in contrast to that of California, for example, which relies on a private certifier, California Certified Organic Farmers (CCOF), and that of Washington, which requires all farmers to be certified through the state. Inspection fees average $250 per year per farm to support the independent inspection structure. Additional fees are based on sales or individual acreage, depending upon the agency.

After seven years of revisions, proposed rules implementing the federal OFPA law were promulgated in 1997. However, these rules were revised and released in 2001. Federal rules require that all farmers who gross more than $5,000 per year from organic sales be certified through an agency accredited with the USDA's National Organic Program (NOP). The small farmer exemption allows small-scale producers to receive the benefits of premium prices (provided produce is raised organically) while avoiding certification fees. This allowance may change in the future, however, and all farmers are encouraged to join a certifying association and a network of organic farmers.

Certification Agencies Practicing in Iowa

Organic Crop Improvement Association (OCIA)
Lincoln, Nebraska
402-477-2323

OCIA Chapter One–Central/Western Iowa
712-367-2442

OCIA Chapter Two–Northeast Iowa
507-583-4581

OCIA Chapter Three–Southeast Iowa
319-592-3266

OCIA Chapter Four–Northeast Iowa
641-435-2156

Farm Verified Organic, North Dakota
701-486-3578

Quality Assurance International (QAI)
San Diego
858-792-3531

California Certified Organic Farmers (CCOF)
831-423-2263

Oregon Tilth
503-378-0690

Organic Labels

In October 2002, the USDA began enforcing a set of national standards that food labeled "organic" must meet, whether it is grown in the United States or imported from other countries. The use of the seal is voluntary, so some organic food products may not carry the new label, but all organic products will carry notification of third-party certification.

Under the new standards, before a food can be labeled as organic, a government-approved certifier must inspect the farm where it is grown to ensure that it was raised according to USDA organic standards. In addition, companies that handle or process food labeled organic must be certified.

The standards permit four different types of organic labeling. Foods labeled "100 percent Organic" must contain 100 percent organically produced ingredients. Products labeled "Organic" must contain at least 95 percent organic ingredients. Packages that state, "Made with Organic Ingredients" must contain at least 70 percent organic ingredients. Packages that claim their products have some organic ingredients may contain more than 30 percent of conventionally produced agricultural ingredients and/or other substances.

The new USDA organic label appears on all certified products in the U.S.

Added water and salt are not counted as organic ingredients. The use of the USDA Organic Seal can only be used on the 95% and 100% organic products.

For more detailed information about the USDA organic labeling requirements or information on how to become certified organic, visit the following Web sites:

http://extension.agron.iastate.edu/organicag/
www.ams.usda.gov/nop/Consumers/brochure.html
www.ams.usda.gov/nop/NOP/NOPhome.html

State of Iowa Organic Certification Program

IDALS began offering a state certification program in March 2000. Farmers may elect to use the state program in place of or in conjunction with a private certification agency. The state program will use similar rules and fee structures as private certification agencies operating in Iowa. For more information, contact Maury Wills, IDALS Organic Program, by telephone at 515-281-5783.

Iowa State University Organic Agriculture Program

Iowa State University operates the Organic Agriculture Program (OAP) to provide research information and extension presentations for Iowans. OAP holds field days, workshops, and an Iowa Communications Network (ICN) series on organics every other year. For more information, contact Kathleen Delate, assistant professor in the departments of horticulture and agronomy, 106 Horticulture Hall, Ames, Iowa 50011, by telephone at 515-294-7069, by FAX at 515-294-0730, or by e-mail at kdelate@iastate.edu.

To sell a product as "organic" the crop must have been raised on land that no synthetic chemical (including fertilizers, herbicides, insecticides, or fungicides) inputs were applied for three years prior to harvest.

Required Certification Practices for Crops

To sell a product as "organic" the crop must have been raised on land that no synthetic chemical (including fertilizers, herbicides, insecticides, or fungicides) inputs were applied for three years prior to its harvest. In addition, no GMO crops (e.g., Roundup-Ready® soybeans and Bt-corn®) are allowed in organic production.

Split operations, which means conventional and organic fields are located on the same farm, are allowed by Iowa law, but they require special care. For example, a border of 25 feet is recommended between organic and conventional fields in mixed operations (see "Organic Soybean Production" section on page 10).

Only naturally occurring materials are allowed in production and processing operations, and all treatments must be noted in farm records.

A crop rotation plan must be in place to protect against pest problems and to maintain soil health. Row crops should be raised for no more than four out of five years, and the same row crop cannot be grown in consecutive years on the same land. Legumes (e.g., alfalfa, red clover, berseem clover, and hairy vetch) alone, or in combination with small grains (e.g., wheat, oats, and barley), should be rotated with row crops (corn, soybeans, amaranth,


K. DELATE

Organic crops are required to be grown in rotations, as demonstrated by the corn-soybean-oat-alfalfa rotation, shown at the I.S.U. Neely-Kinyon Farm.


K. DELATE

Organic livestock must be fed 100 percent organic feed and hay.

and vegetables) to ensure a healthy system (see "Soil Health" section, page 9). A typical six-year rotation in Iowa is corn (with a cover of winter rye)-soybeans-oats (with an underseeding of alfalfa)-alfalfa-corn-soybeans. Horticultural crops should be rotated with a leguminous cover crop at least once every five years to enhance soil quality.

Organic production specifically prohibits certain practices, such as the use of biosolids, or sewage sludge, due to concerns about bacterial and heavy metal contamination. Irradiated products also are prohibited because irradiated elements do not occur in nature. Examples of products used in organic crop production are described in the "Examples from the Field" on page 10.

The first step in making the transition to certified organic production is contacting a certification agency.

Required Certification Practices for Livestock

Purchasing (or raising your own) parasite-free, organically-raised stock and providing access to ample pasture, water, and nutritional feed should allow for healthy organic livestock production. Livestock must receive 100 percent organic feed. Synthetic hormones and antibiotics are not permitted; however, the natural bacteria present in vaccinations is permissible. Synthetic parasiticides are not allowed; instead, organic farmers rely on natural parasiticides, such as diatomaceous earth (DE). Livestock must have access to pasture in order to be certified organic. Alternative health therapies, such as botanical remedies and muscle manipulation, are used by some organic livestock producers. Organic cows must be raised as organic (following prior specifications) in the final trimester in order to sell calves as "organic." Supplements (vitamins, minerals) must be approved by your certification agency and must not be listed as Prohibited Substances of the National List (www.ams.usda.gov/-nop/NationalList/ListHome.html).

First Steps to Certification

The first step in becoming certified for organic production is contacting a certification agency. By joining a local organic certification association, organic farmers may participate in various meetings, field days, and visits to organic farms. Certain sections of land can be converted (such as CRP) immediately into certified organic status if no synthetic chemicals (including Round-Up® and fertilizers) have been applied for the previous three years.

During the three-year transition to certified organic production, records should be kept on all substances applied to the land. An inspector will visit the farm in the third year (or the year the farmer anticipates selling his or her crop as organic) and review all records, crops, storage bins, and equipment used on the farm to assure compliance

with organic standards. The farmer will be issued a certificate upon completion of inspection and approval by the certification board. Certification fees are based on an inspection fee (average cost is $250/year) and anticipated acreage/livestock costs (average total fees are $3/acre).

Marketing

Although the organic industry began as a niche market, steady growth has led to its place as a segment market since 1997. The organic dairy industry expanded by 73 percent from 1996 to 1997 and continues to grow. Organic markets can be divided into indirect and direct markets. Indirect or wholesale markets include cooperatives, wholesale produce operations, brokers, and local milling operations for organic grains (see companies listed on page 14). Many supermarket chains buy directly from farmers (organic certificates are required) or from wholesalers of organic products. Because meat now can be labeled as organic, the marketing of organic beef, pork, chicken, and lamb has been simplified significantly.

Although the organic industry began as a niche market, steady growth has led to its place as a segment market since 1997.

Roadside stands, farmers markets, and community supported agriculture farms (CSAs) constitute the direct marketing end of the organic industry. There are approximately 1,000 CSAs across the United States. In CSAs, clients support a farm's production by purchasing a share, which can range from $200 to $400/season. For each share, clients receive an average of 15 pounds of produce per week. For more information on CSAs, see the Iowa State University Extension publication on Iowa CSA Farms (PM 1693).

J. DEWITT

Farmers markets offer opportunities for small- and large-scale operations.

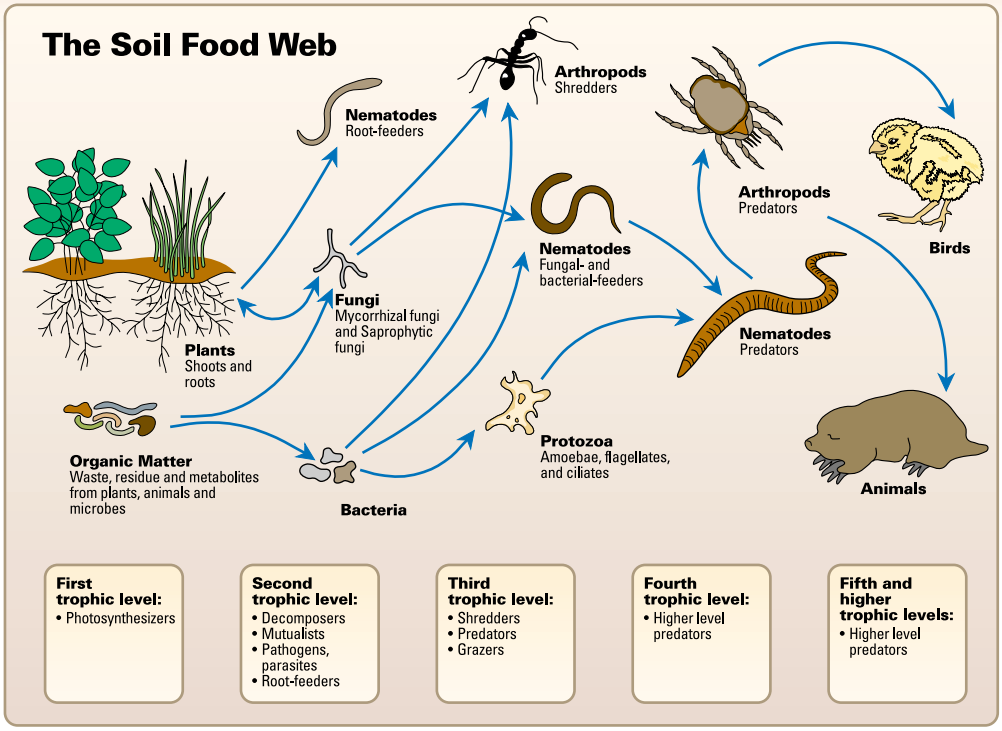
Premium Prices

According to the Organic Alliance (www.organicalliance.org), organic premiums range from 20 percent to 400 percent above conventional prices, depending on the season and availability of the product. As an example, premium prices for organic carrots have ranged from 27 percent in the summer growing season to 200 percent in the winter months. Most consumers relate their willingness to pay premium prices for food raised without synthetic chemicals to their concerns about food safety and the environment.

Subsidies

Although many European countries financially support their farmers' organic production practices, the United States has made small gains in this area. In Iowa, the Natural Resources Conservation Services (NRCS) offers organic farmers $50/acre during their transition to organic farming through the Environmental Quality Indicators Program (EQIP). and through the new organic cost-share programs with the 2002 Farm Bill. Check with local NRCS or FSA offices regarding deadlines and required documents. Other conservation practices used on organic farms (e.g., riparian buffer strips, filter strips, and crop rotations) also may qualify for cost sharing.

The basis for all organic farming systems is the health of the soil.



Soil Health: The Basis for Organic Farming

Organic farmers strive to maintain adequate fertility as well as biologically active soil with the microbial populations required for nutrient cycling. Crop rotation provides nutrients such as nitrogen from legume crops and carbonaceous biomass upon which beneficial soil microorganisms depend for survival. Naturally mined lime products, manure, and composted manure are the most common forms of soil amendments for organic operations. Iowa rules specify the number of months prior to harvest that manure should be applied to allow adequate decomposition and to avoid bacterial contamination of produce. Manure cannot be applied for a minimum of four months prior to the harvest of horticultural crops and for three months prior to agronomic crop harvest. Raw manure cannot be applied to frozen or snow-covered ground.

Composting, the preferred method of stabilizing manure, is a controlled process in which nitrogen-containing materials are mixed with a carbon-containing source to produce a substance preferably in a carbon-to-nitrogen ratio (C:N) of 30 to 1. Compost temperatures must reach 131–170°F for 15 days, and be turned a minimum of 5 times to aerate the pile. Additional information on composting practices is listed in the references.

Organic farmers strive to maintain adequate fertility as well as biologically active soil with the microbial populations required for nutrient cycling.

Though many soil amendments are available for organic farming, these materials must be **naturally based.** In addition to manure-based fertilizers, many organic farmers rely on fish emulsion and seaweed preparations to supply nitrogen and other

K. DELATE

In trials at Iowa State University, organic peppers fertilized with compost produced equivalent yields compared with non-fertilized plants.

K. HAGEN

Green lacewings are prominent predators on organic farms in Iowa.

elements. When phosphorus and potassium limit crop production, rock phosphate and naturally mined potassium chloride are allowed. It is imperative that organic farmers check with their certification agencies before applying any materials. Certification may be revoked for up to three years if a material contaminated with prohibited materials is applied.

Pest Management: Working with Nature

The basis of insect, disease, and nematode management in organic farming systems is the reliance on the inherent equilibrium in nature. Most insect pests have natural enemies to keep their populations in check. Natural enemies include insect predators (insects that consume part or all of pest insects), parasites (insects that use other insects to produce their offspring, thereby killing the pest insect in the process), and pathogens (diseases that kill or decrease the growth rate of insect pests). Predatory insects on organic farms include lady beetles, lacewings, and spiders. Parasitic insects include wasps and flies that lay their eggs in/on pest insects, such as larvae or caterpillars.

Beneficial insects exist naturally on farms, or they can be purchased from commercial insectaries and released seasonally. Also available are commercial preparations of natural insect pathogens, such as *Bacillus thuringiensis (Bt)*, which are used to manage pestiferous larvae such as corn borers.

Botanical insecticides, such as neem and ryania, also are allowed in organic production, but as with all insecticides, they should be used only as a last resort. Although these materials are naturally based, some materials may affect natural enemies.

The basis of insect, disease, and nematode management in organic farming systems is the reliance on the inherent equilibrium in nature.

Prevention is a cornerstone of organic farming. Only pest-free seeds and transplants should be brought onto organic farms. Physical and cultural methods are used to prevent pest infestations. Physical methods include the use of row covers for protection against insects, such as cabbage butterflies and aphids. Cultural methods include sanitation (destroying all infested plant material at season's end) and resistant varieties. The varieties used in organic farming have been bred traditionally (i.e., no manipulated gene insertion or engineering involved) for insect, disease, and nematode resistance or tolerance.

K. DELATE

Propane flame burners can be used on organic farms to control weeds between and within rows.

Weed Management: Multiple Tactics Work Best

Most organic farmers rely on multiple tactics for their weed management. Allelopathic crops, cultivation, mulching, and flame burning are methods available to organic farmers. Depending on the crop, cultivation offers the least labor-intensive method of weed management. Timely cultivation is key; weeds will proliferate without specific schedules. Propane flame burning is generally used in conjunction with cultivation, particularly during times of high field moisture. Mulching with straw or wood chips is a common practice in many horticultural operations. Mulch from organic farms is preferred to avoid any possibility of pesticide residues from conventional materials. If organic sources are not available, turning the mulch pile for several weeks prior to application is recommended (follow composting practices). Allelopathic crops, such as rye and oats, exude a chemical that mitigates against weed establishment and seedling vigor and are recommended between corn and soybean crops.

Most organic farmers rely on multiple tactics for their weed management. Allelopathic crops, cultivation, mulching, and flame burning are methods available to organic farmers.

J. DEWITT

Organic strawberries are commonly mulched with straw to prevent weeds and disease, aid in moisture retention and keep fruits free of soil particles.

Examples from the Field: Organic Soybean Production

Preplanting and Seed Selection

Organic soybeans were grown on approximately 60,000 acres in Iowa in 1998. Though the market remains strong for organic soybeans, determining your market should occur before any acreage is planned. Buyers will help determine the varieties their organic farmers should grow based on their needs. A list of some of the buyers operating in Iowa is included on page 14. All organic soybean varieties are bred for the food-based tofu or natto market (e.g., specific seed size and protein requirements).

The ideal crop preceding soybeans is winter rye, an allelopathic crop, to help prevent weed establishment. In the spring, rye that is less than 8 inches in height can be killed with a field cultivator. If plants are taller, rye should be mowed or cut with a stalk chopper before cultivating or disking to kill the rye. A second cultivation may be necessary if there are any remaining rye plants.

Fall soil sampling will help determine if soil is adequate for soybean production. Adjustments to a

K. DELATE

Many organic farmers plant a cover crop of winter rye on ridges prior to their soybean crop to assist in erosion and weed prevention.

K. DELATE

Rotary hoes or harrows are the first tillage operation used on organic farms.

K. DELATE

Row cultivators are used two to three times to control weeds between rows.

proper soil pH of 6.5 to 7.0 can be made through applications of lime in the fall or spring (usually Iowa soils do not require dolomitic lime). Phosphorus may also be required and can be supplied through composted manure or rock powders. Seeds are planted when the soil is adequately warmed for this tropical crop (usually around May 15), 1 inch deep, in a planting population ranging from 175,000 to 225,000 seeds/acre (depending on the variety). Seeds normally are planted in 30 or 36 inch rows, depending on planting/cultivating equipment specifications. Seeds planted in narrower rows have been attempted, but currently, the most economical method of weed management requires cultivators, which usually cannot fit narrow rows.

Pest Management

Weed management is key to a successful organic crop. Three to five days after planting, fields are rotary-hoed at a slow speed (5 mph) to kill weeds in their initial germination or white-thread stage. A harrow also can be used at this stage. One week later, after soybeans have emerged, fields are hoed again at a faster speed (7–9 mph). Two- to three-row cultivations are a normal practice. The first cultivation is at a slow speed, as soon as rotary-hoeing ends. The second cultivation is at mid-season at a faster speed to throw about one inch of soil around the base of plants. The third cultivation is at a slow speed (5 mph).

Weed management is key to a successful organic crop.

Various attachments and plant protection devices can be added to cultivators (see the reference *Steel in the Field,* produced by the USDA Sustainable Agriculture and Research Education [SARE] Sustainable Agriculture Network, available from Iowa State University).

Insects generally do not cause yield loss in organic soybeans. Occasional browsing by grasshoppers, leafhoppers, and bean leaf beetles rarely

surpasses economic threshold levels. An issue of growing importance, however, is the relationship between the bean leaf beetle and a host of soybean seed diseases.

Because the majority of organic soybeans are destined for the edible tofu market, a white seed color is required. Soybeans will enter the organic feed market at a reduced price if there is purple, brown, or tan staining from *Cercospora, Fusarium,* soybean mosaic virus, or bean pod mottle virus, transmitted by the bean leaf beetle. Although certain varieties appear to resist staining, high rainfall during pod set may create ideal conditions for the spread of the disease in any variety. Soybean cyst nematode has not been found to be a problem on organic farms. Several factors, including crop rotations and chemical exudates from crop residues and manure applications, may mitigate against nematode survival. Soil sampling two weeks prior to harvest is recommended to determine any possible nematode introductions. Non-GMO SCN-resistant varieties can be used if infestations are detected.

If any GMO seeds are found in organic lots, the entire field can be rejected for organic certification.

Harvesting and Storage

Harvesting and storage of organic soybeans represent the final key areas of concern in garnering premium prices. The contract will dictate the desired seed size, moisture content, and cleanliness of the soybean harvest. Certain weed seeds, such as nightshade, can stain soybeans and must be weeded from fields prior to harvest. In general, organic farmers plan for one hour of hand-weeding, or walking, for every acre of soybeans.

It is imperative that separate combines are used for organic and conventional fields or combines undergo a thorough cleaning (a minimum of two hours) between conventional and organic fields. Iowa State University has a video describing the combine clean-out procedures (Combine Clean-Out Procedures for Identity-Preserved Grains, EDC-255).

If any GMO seeds are found in organic lots, the entire field can be rejected for organic certification. Certain specifications in combine settings must be followed in order to prevent any soil from contaminating the edible beans. Smooth plates, dual rotating screens, and slower speeds are used to avoid splitting seeds and lowering seed quality. Seed moisture also is a concern; seeds should be harvested at full size from 16–13 percent moisture to avoid cracking or shriveling in the case of immaturity.

Because soybeans may not be sent to market for periods ranging from one week to six months (depending on the buyer's scheduling), storage facilities are necessary. Again, separate storage facilities for conventional and organic crops are required. Proper seed moisture content should prevent the need for additional drying, but fans and drying facilities should be used to adjust for seasonal differences. Diatomaceous earth (DE) can be mixed in storage bins to prevent insect contamination. This substance is nontoxic to humans but damages the exoskeleton of insects and causes death. Moldy or "buggy" soybeans will be rejected.

Many buyers require a sample of soybeans prior to accepting a load. Soybeans will be screened

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Harvesting and storing organic soybeans are important steps in collecting a premium price.

based on size and will be tested for GMO contamination. Most buyers allow a certain percentage of "clean-out" (generally less than 15 percent). Screened beans (small sized or split seeds) can enter the organic livestock feed market. Stained beans either can enter the organic livestock market or be blended into other clean streams (if less than 3 percent are stained). The staining does not affect the nutrition of the tofu or natto, but it can affect the texture and color.

Economics

Cost-of-production studies for organic and conventional tofu soybeans are presented in Tables 1 and 2.

Costs for 1998 represent actual costs incurred at the Iowa State University Neely-Kinyon Farm.

Table 1

Comparison of Organic and Conventional Clear-Hilum Soybean Economic Analysis, Greenfield, 1998

Production Costs (actual cost per acre)	**Organic**	**Conventional**
Moldboard plowing	$8.10	$8.10
Disking	4.00	4.00
Field cultivation (preplant)	4.00	4.00
Fertilization	0	0
Planting	9.00	9.00
Seed	31.60	22.00
Herbicide	0	10.38
Sprayer	0	2.50
Rotary hoeing (2x)	4.00	4.00
Row cultivating (2x)	7.00	7.00
Hand-weeding	14.00	14.00
Combining	21.00	21.00
Hauling grain to market	0 (FOB per contract)	3.00
Total cost per acre	**$102.70**	**$108.98**
Returns	$850.00 50 bu/A x $17.00/bu	$312.00 48 bu/A x $6.50/bu
Profit per acre	**$747.30** Excluding price of land	**$203.02** Excluding price of land
Organic profit	368%	

Table 2

Estimated Economic Analysis, Adjusting for On-Farm Costs in 1999

Production Costs (per acre)	**Organic**	**Conventional**
Land	$100	$100
Certification fees	$15	0
1999 Total costs per acre	$217.70	$208.98
1999 Returns	$700 $14/bu x 50 bu/A	$300 $6/bu x 50 bu/A
1999 Profit/acre	$482.30	$91.02

Soybeans currently are the most lucrative crop in the system, but new markets for non-GMO crops and alternative crops, such as organic dry beans, hay/silage/grain for organic dairies and equestrian centers, and medicinal/culinary herbs, continue to grow.

Iowa State found that projected costs of production for similar operations were comparable in 1998. Selling price for organic crops represented 1998 prices (free on board [F.O.B.] or pick-up on the farm). Prices also reflect the obtainable price for certified organic crops or crops grown on land without synthetic chemicals for three years prior to harvest. Transition soybeans were sold for $10 per bushel in 1998, but because of the availability of organic soybeans in 1999, there were limited markets for transitional soybeans. Selling price for organic soybeans in 1999 averaged $14 per bushel. Averaging across all crops in a typical rotation for certified organic systems, Iowa State University research demonstrated a return of $300/acre. Soybeans currently are the most lucrative crop in the system, but new markets for non-GMO crops and alternative crops, such as organic dry beans, hay/silage/grain for organic dairies and equestrian centers, and medicinal/culinary herbs, continue to grow.

Buyers of Organic Grains, Produce, and Livestock

Heartland Organic Marketing Cooperative
Stuart, IA
515-523-1888

Pacific Soybean and Grain
San Francisco, CA
415-433-0867

Profiseed International, Inc.
Hampton, IA
641-456-5955

Clarkson Grain
Beardstown, IL
217-323-2350, 800-252-1638

Dunn International
Waterloo, IA
319-233-5504

Pattison Brothers
Fayette, IA
800-632-5952

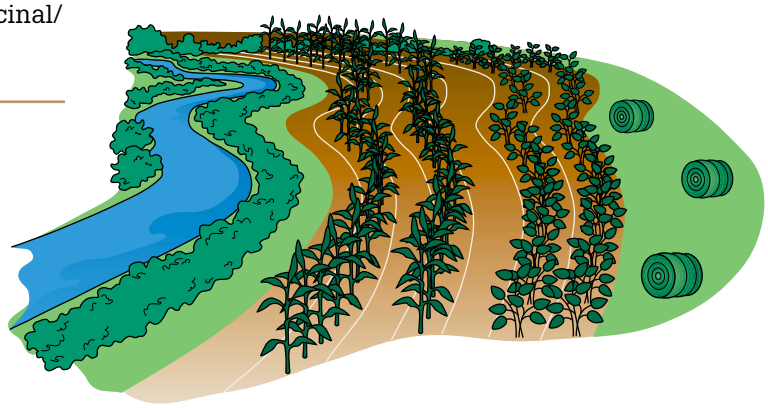
Stonebridge Limited
Cedar Falls, IA
319-27

Sunrich
Hope, MN
800-342-6976

Microsoy Corporation
Jefferson, IA
515-386-2100

Natural Products
Grinnell, IA
641-236-0852

Organic Valley/CROPP
(Coulee Region Organic Produce Pool)
LaFarge, WI
608-625-2602



Examples from the Field: Organic Apple Production

Organic apple production represents one of the most intensively managed organic systems. Because scab is the most destructive disease of apples in Iowa, it is imperative that growers select disease-resistant varieties suitable for this state. Iowa State University has tested the following varieties and found them to be suitable: Jonafree, Redfree, Liberty, Freedom, Dayton, William's Pride, Gold Rush, Enterprise, Priscilla, and Nova Easygro.

Trees should be purchased from a reputable nursery and should be free of diseases and insects. Graft marks should be well above where trees will be placed (even with the soil surface). Trees should be planted in the spring after threat of frost has passed. Today, most growers are planting on dwarf or semi-dwarfing root stocks. Trees can be trellised or planted in normal rows. Apple blossom thinning to increase size of harvested fruits is normally conducted by hand, but natural sprays are being used in large, commercial orchards in other parts of the country.

Pest management in apple orchards includes control of the plum curculio, apple maggot, codling moth, and leaf-eating larvae (caterpillars). Codling moth management includes pheromone traps or ties placed on branches, which emit a chemical that disrupts the mating ability of the codling moth and leads to lower insect populations. The plum curculio beetle can be controlled through physical means: teams of workers displace beetles by tapping trees with baseball bats or sticks wrapped in cotton cloth. Beetles drop from trees onto squares of white sheets placed under trees to be collected and burned or buried. Apple maggot flies are managed through the use of Stickem®-coated plastic red balls resembling apples. Adult flies cue in on the shape of the ball and attempt to oviposit eggs. Kaolin clay sprays, have proven successful in mitigating egg laying from the codling moth and plum curculio. This clay-based spray has been reported to lower plant pathogens affecting apple leaves, but our research has shown only insect control due to low disease pressure in our trials (Friedrich et al., 2003).

Organic apple production represents one of the most intensively managed organic systems.

K. DELATE

Unblemished organic apples can be grown when growers employ rigorous pest management practices.

Weeds are managed in tree middles by mowing ground covers, usually a mix of grass and legumes. Specialized mowers are available with articulated hydraulic arms to mow between trees within rows. Some growers use Weed Badgers® to cultivate around trees, but caution must be used to avoid damage to trees and root systems. Protection from deer browsing can include perimeter fencing and/or individual cages when trees are young. Many growers employ alarms or dogs within their orchards to prevent deer attacks.

Marketing of organic apples can occur through several channels—on-farm sales, CSAs, or directly to stores. Stores will require proof of organic certification if you wish to sell your fruit as "organic."

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This research project is partially funded by the Leopold Center for Sustainable Agriculture at Iowa State University and the USDA-IFAFS Organic Agriculture Consortium.

Prepared by Kathleen Delate, Iowa State University.

Edited by Jean McGuire, ISU Extension Continuing Education & Communication Services.

Illustrated by Jane Lenahan.

Designed by Mary Sailer, Spring Valley Studio.

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Some photos on the cover were provided courtesy of Iowa State University College of Agriculture and the USDA NRCS.

For the latest on organic agriculture from Iowa State University go to **http://extension.agron.iastate.edu/organicag/.**