Organic Farming Practices

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Organic farming was described as a system prior to World War I by Sir Albert Howard who taught that except for "natural phosphate rock and limestone, imported off-farm plant nutrients should be avoided". During World War Ⅱ, J.I. Rodale applied these methods on an experimental organic farm in Pennsylvania and published *Organic Farming and Gardening* magazine which, along with other Rodale Press publications, popularized organic farming. In the 197Os, regional organic groups like the Califomia Certified Organic Farmers, Oregon Tilth, the Organic Growers and Buyers Association, and other groups in the U.S., Canada, and Europe established standards for organic production and certfication. In the 198Os, Florida Certified Organic Growers and Consumers, Inc. (FOG) was formed in Gainesville and has become the major organic certifying agency in this state, certifying 71 out of 88 organic enterprises in Florida (Anon., 1997). On the national level, the Organic Foods Production Association of North America developed as the major trade association in the 1980s, representing growers, shippers, processors, certifiers, distributors, and retailers. The International Association of Organic Agriculture Movements (IFOAM) has established international production, processing, and trading standards, and represents the international organic movement in parliamentary, administrative, and policy-making forums like the Food and Agriculture Organization of the United Nations,

Increasing interest in organic farming prompted passage in 1990 of the Florida Organic Fanning and Food Law and the federal Organic Foods Production Act. The Florida law established a regulatory framework for organic certification and created an organic food advisory council to advise the Commissioner of Agriculture on organic farming issues, licensing of certifying agents, and policies to promote organic products. The federal law provided for USDA to develop national standards for organic crops, livestock, processing and handling; establish a materials list of approved inputs; set up an accreditation process for the review of certification agencies and establish protocols for imported organic products. Since 1990, the USDA has obtained public input in regional meetings throughout the U.S. in developing recommendations made by a 14 member National Organic Standards Board (NOSB), leading to eventual rule-makmg by the USDA. Long awaited implementation of the Organic Foods Production Act is expected to bring nationwide standardization of organic methods, materials and processing, stimulating industry growth domestically and internationally.

Organic agriculture has been generally defined as a "holistic system with the primary goal of optimizing the health and productivity of interdependent communities of soil life, plants, animals, and people". Management practices are carefully selected with an intent to restore and then maintain ecological harmony on the farm, its surrounding environment and ultimately the whole planetary system.'' (Anon., 1995a). Organic farming is a subset of sustainable agriculture that stresses ecological balance in agricultural and livestock production by developing healthy soils, which is the basis for organic production, and high quality crops and livestock. Careful selection of crops and plant cultivars complements continuous improvement of soil organic matter and soil fertility, particularly through green manuring and addition of composted materials, manures, and rock minerals. Although organic certifyingagencies and NOSB tentative recommendatinos differ somewhat in allowed, regulated, and prohibited practices, a general review of current organic standards and certification procedures will be presented here.

CERTIFICATIONPROCEDURES

Certification focuses on intent (a farm management plan), evidence (history of a 3-yr transition period free of prohibited materials), and documentation (soil, leaf and water analysis, crop plans, field history sheets, receipts, and afficavits). At the heart of organic management is the farm plan, including Written strategies for ecologically sound resource management, plans and evaluations of farm management practices and tangible improvements in the fanning operation. This plan must address soil, crop, and resource management, as well as crop protection and maintenance of organic integrity through growing, harvest, and post-harvest operations. Buffer zones up to 30-A and/or appropriate barriers must

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separate organic from conventionally-farmed fields or other lands subject to synthetic spray or fertilizer programs. Separate records, physical facilities, machinery, and management practices must be established to prevent the possibility of mixing organic and non-organic products. Areas may not be switched back and forth between organic and non-organic management practices. If individual fields are certified, the entire farm must be certified within 5-yr of certification of the first field, according to international standards (IFOAM) but not according to those of some U.S. certifying agencies. However, NOSB recommendations leave this to the discretion of the grower. In general, synthetic materials are prohibited, but some synthetic materials are considered to be compatible with the goals of organic agriculture and are allowed. (e.g. pheromones and insecticidal soaps). A transitional status, involving management without the use of prohibited materials for 12-m before harvest, may also be obtained by previously uncertified farms and livestock operations. For "wild land," documentation is required that the land has been pesticide-free for 3-41, along with a management plan. Abandoned fields or groves to which no prohibited materials have been applied for 3-41 will not be certified because of lack of active management.

Packets containing certification information (40 to 60 pages) can be obtained from certifying agencies for $25 to $35, with additional first-year and annual renewal fees ranging from $125 plus a flat 0.0025% of gross annual sales which exceed $15,000 for one certifying agency (Anon., 1996) to a sliding scale based on projected sales for the first year and on actual gross sales from previous years for another agency. In the latter case, fees vary from 7.4% and 4.5% for first and second year Certification for sales of 0 to $5,000 to 0.5% and 0.4% of total sales of $500,000 (Coody, 1994). Processors pay *0.5%* of net invoice sales for certification and handlers pay 0.1% of gross profit. Growers who sell less than $5,000 annually may be exempt from certification under future NOSB agency standards but will be required to prcduce and handle organic products in accordance with organic production and handling standards.

LIVESTOCK

Anunals must be raised for their life on organic feed and pasture under living conditions that foster herd and flock health, without the application of prohibited drugs and substances except as allowed. Livestock must also be provided with living conditions that minimize stress and are suited to individual and collective needs, with enough room to comfortably sit up, lie down, groom normally, turn around and stretch. Breeding stock may be bought from whatever source, provided the animal is not in the last third of gestation, but may be sold as certified organic only if raised in compliance with organic standards for one year following purchase. Dauy stock purchased from non-certified sources is restricted. New and certifiable herds should be fed a minimum of 50% daily ration of organically grown feed for 6-m followed by being fed 100% certified feed for 6 to 12 m (depending on the certifier) prior to the milk being certifiable. Antibiotics and Normanist are generally prohibited in organic dairies and water for dairy animals must be less than 10 mg nitrate N per liter. Plastic roughage, urea, intentional manure refeeding, and similar practices are prohibited. Stacked cage confinement and overcrowding of poultry is prohibited, and laying stock must be managed in accordance with organic production standards for at least 4-m before eggs can be certified. Although certified organic meat products can be produced and sold in-state, final USDA rules on organic meat production must first be promulgated before interstate shipment of these products can occur, creating additional temporary marketing problems for organic beef, poultry, and other products.

SOIL MANAGEMENT

A basic tenet of organic farming is that a healthy soil produces healthy plants. Accordingly, application of soil amendments and fertilizers, especially soluble ones, must be judged by the criteria of soil health and crop requirements, for optimum, not maximum, production. Soil fertility is maintained by managing organic matter and mineral content through tillage, crop rotation, incorporation of green and animal manures, and addition of soil amendments and natural fertilizers like rock minerals. Crop rotation includes alternation of sod and row crops and crops which do not share similar pest complexes; N-fixing crops; green manure crops, cover and nurse crops; alternation of heavy and light feeders and use of plants with allelopathic or mineral accumulating properties. Tillage is used to control weeds, disrupt pest and disease cycles, and improve nutrient levels, tilth, and organic matter. Mono-cropping is prohibited, with two-crop rotation regulated and a three-crop rotation accepted as a minimum. Plant tissue and soil testing, including organic matter content, levels of macro and micronutrient, pH, cation exchange capacity, soil texture, bulk density, and water infiltration rate, are used to monitor soil health and indicate the direction of a soil management program. Animal manures, especially chicken manure, are the primary fertilizer used by organic growers but only as a

supplement to other soil building practices. Records must be maintained on manure type, source and application date, site, method, and rate. Composted rather than aged or raw manure is encouraged, preferably produced on-farm and if produced off-farm, free of contaminants Some certifying agencies specify that fresh manure be applied only when soil temperatures are greater than 50°F or higher, moisture content between field capacity and wilting point, and that application must not result in contamination of surface or ground water or in excessive nitrate concentrations in produce. Fresh manure may not be used on crops destined for human consumption less than 4-m before harvest. Manure aged by the producer 90-d or more can be applied 30-d before harvest of such crops. Approved N sources include green manures and animals manures, N-fixing crops, composted materials, and N-fixing organisms, with certifying agencies differing on recommendations for fish emulsion, vegetable meal, bone meal, and other animal by-products. Although certifying agencies generally prohibit Chilean or calcium nitrate (16-0-0), the National Organic Standards Board recommends that this material be limited to not more than 20% of the total N supplied to a crop. Furthermore, farmers must develop strategies to substantially reduce the use of Chilean nitrate over time. Approved P sources include colloidal and rock phosphate, with synthetic materials like ortho phosphoric acid (0-50-0), superphosphate (0-20-0) and triple superphosphate (0-46-0), prohibited, as are other excessively soluble and acidfying materials with a high salt index. Approved K sources include rock dust (granite, feldspar, greensand), mined potassium sulfate, sulfate of potash magnesia (sulfamag or langbeinite) and kainite. Application of biosolids is regulated by some certifying agencies and prohibited by others.

PLANTING STOCK

Organic production methods apply to the entire life of the plant. Seedlings and other planting stock should not be treated with any prohibited materials. However, use of planting stock treated with synthetic materials is regulated if organic materials are not available. Transplants must be organically grown but some certifying agencies allowed conventionally-grown transplants for strawberries, caneberries, potatoes, garlic, shallots, and bare-root nursery stock for perennials. Organic management for 1-yr prior to harvest is required for perennial planting stock (tree fruits, grapes and small fruits of genus *Rubus, Ribes,* and *Vaccinium)* which are not produced from organic stock. In greenhouse production, lumber treated with copper-chromium arsenate is classified as a restricted material but can be used where plant leaves or roots do not contact such treated wood. Organic and non-organic sites must be separated by an impermeable wall and ventilation systems must ensure that prohibited materials do not drift from non-organic to organic production sites. Apiaries must be located on certified land more than two miles from areas like golf courses, major townsites, cities, major traffic polluting areas, garbage dumps or crops sprayed with prohibited pesticides that could contaminate the honey.

DISEASE *AND* PEST MANAGEMENT

Careful management, *use* of resistant varieties, timing to avoid cycles of pest emergence, crop rotations, inter-cropping, avoidance of excessive fertilization, and general maintenance of soil health is the first line of defense against weeds, pests, and disease. Mechanical controls, such as traps, repellant crops, vacuuming water jets, and physical and sound barriers are generally recommended as are the release of natural predators and parasites, mating disruptors, and the creation of environments fostering wild predators such as birds, toads, and snakes. Sprays including insecticidal soaps, microbial sprays, rock powders and diatomaceous earth, herbal preparations, dormant oil sprays in orchards, solutions of pureed insects or plants used as repellents are allowed. Botanical and other natural insecticides such as pyrethrum rotenone, sabadilla, quassia, ryania, and neem that have broad-spectrum effects are generally regulated. Weed management includes prevention, avoidance and sanitation; mechanical methods including tillage - discs, choppers, mechanical hoes, and non-tillage - rotary mechanical mowers, sickle-bar mowers, and devining equipment; grazing, including weeder geese and animal rotation in pastures; heat treatments, including flame hoes with gas and superheated water, mulches, including use. of organic material, intercrop plants as well as covers of different types; crop rotation and smother crops. Polycarbonate plastic mulches (polypropylene and polyethylene), mulching with recycled newspaper and magazines containing inks and dyes and herbicides from naturally occurring fatty acids are regulated as are polyvinyl chloride plastics. When inadvertent environmental contamination or pesticide drift occurs, tolerance levels are set at no more than 5% of Environmental protection Agency (EPA) tolerance levels, with responsible private parties liable for damages.

GENETICALLY MODIFIED ORGANISMS

Genetic engineering refers to organisms "made with techniques that alter the molecular or cell biology of an *organism* by means that are not possible under natural

conditions or processes. Genetic engineering includes recombinant DNA or RNA techniques, cell fusion, micro-and macro- encapsulation, gene deletion and doubling, introducing a foreign gene, and changing the positions of genes but not breeding, conjugation, fermentation hybridization, in-vitro fertilization, and tissue culture" (Anon., 1995b). Genetically-engineered organisms and irradiation of crops are prohibited, but the results of classical plant and animal breedmg are allowed. Genetic engineering is prohibited in order to guarantee a common standard for all organic farmers and consumers, many of whom are both philosophically opposed and wary of the Pandora's box this approach may open. Artificial insemination is also allowed but not embryo transfer.

Although state Department of Agriculture and certifying agencies maintain data for organic certification, farm location, acreage farmed, and commodities grown, it is difficult to obtain accurate informatino, especially on crop production, and sales .According to a recent Florida Department of Agriculture listing (Anon., 1997), 88 enterprises were certified organic by 1997 by five of the six certifying agencies licensed in Florida, with acreage and crops of only 67 enterprises specified. Thirteen of these 67 firms were juice, fruit, and vegetable packers and processors. Of the remaining 54, 52 were farms producing fruit and vegetable crops on 2,836 acres (27 citrus groves on 1, 941 a, 17 vegetable farms on 740 a, with two more enterprises on 15,267 a or 84% of the total Florida organic acreage, in wilderness crops (saw palmetto berries and herbs).

More specific information indicating trends is available from California, which has an older and better organized organic farming industry (Klonsky and Tourte, 1997). In 1992-93, in California, 1,159 organic farmers sold more than 70 individual commodities produced on 45,493 a with sales of $75.4 million. Fruit and nut crops and vegetable crops represented 96% of the gross sales on 75% of all acreage. Fruit and nut crops comprised 42% of the total organic acreage, vegetable crops about 31%, and field crops 18%.

Vegetable crops were the highest value commodity with $37.7 million, representing 50% of the total gross sales (Table 1). Although approximately 4,050 U.S. organic *crop* and livestock producers on 0.2% of total U.S, farms were certified by 1994 on approximately 0.1% (1,127,000 a) of total U.S. agricultural land (Dunn, 1995), consumer and farmer interest in organic farming is increasing because of personal concerns about food safety and environmental stewardship as well as marketing opportunities. With dramatic sales increases predicted for this well defined and documented agricultural sector, especially in large urban markets (Burfield, 1996), national agricultural policy, regulatory and marketing leaders are watching this emerging industry carefully.

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Table 1. Characterization of California organic farms by commodity group, 1992-93*

Commodity group	Number of farms	Median a	Median sales (%/farm)	Median sales ($/a)
Vegetable crops	293	2.3	9,500	3,250
Fruit and nut crops	652	6.0	6,000	1,393
Field crops	25	80.0	50,000	361
Combined fruit, nut, and vegetables crops	70	3.3	5,235	2,009
Livestock, layer hens and poultry	5	N/A	5,000	N/A
Nursery and flowers	1	3.0	10,000	3,333
Mixed commodity groups	113	9.0	13,000	1,406
All farms	1,159	5.0	7,500	1,685

* Klonsky and Tourte, 1997.