

# **Organic Production Methods**

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## **Outline**

- Whole Farm Planning
- Crop Rotation and Biodiversity
- Soil Management
- Pest Management
- Resources for Organic Production

## **Whole Farm Planning**

### **Whole Farm System Pyramid: Information**

- The glue that binds it all together
- Gathering is a continuous job
- From where?
  - Records
  - Customer feedback
  - Conferences and trade shows
  - Farm tours
  - Written info from all sources
  - Study, observe, think!

### **Whole Farm System Pyramid: Marketing Plan**

- Affects everything and sets the whole train in motion
- Where to market and why
- What to market and why
- When to market

### **Whole Farm System Pyramid: Soil Fertility**

- Get the soil right and don't depend on supplements or you will fail
- Two phases
  1. Building
  2. Maintaining balance
- Sources of fertility
  - On-site: nutrient cycling, manure, cover crops
  - Off-site: think about all the costs

### **Whole Farm System Pyramid: Rotations**

- The most important pest management tool
- Hand-in-hand with soil fertility
- Diversity is the key ingredient
- Include cover crops, animals, perennial crops and rest periods in planning

### **Whole Farm System Pyramid: Field Planting Decisions and Farm Design**

- Transplants vs. direct seeding
- Spacing
- Timing
- Efficiency and access
- Equipment

### **Whole Farm System Pyramid: Labor**

- The most limiting factor in the system
- The most expensive input
- Spread labor out, balance production
- Use efficiently and sparingly

### **Whole Farm System Pyramid: Weed Control, Irrigation, Trellising**

- Timing, rotation, and planting decisions are key to weed control
- Do not even consider high value crops without irrigation
- Drip irrigation is most efficient, fewer disease problems
- Trellising improves space efficiency, disease control, harvesting speed, crop quality

### **Whole Farm System Pyramid: Harvest and Postharvest**

- Proper time and maturity
- Get the heat out and keep it out
- Quit messin' with it
- Store it right
- Get it to market ASAP

### **Whole Farm System Pyramid: Pest Management**

- If you did everything else right this is the least important part of the system
- Problems are generally an indication that some part of the system is not working properly

### **Organic Production**

The National Organic Standard defines organic production as a production system that “responds to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity”.

### **Promoting Biodiversity**

- Crop rotation
- Cover crops
- Minimize soil disturbance
- Limited use of broad-spectrum pesticides
- Conservation and augmentation of beneficial organisms
- Intercropping
- Multiple cultivars and species
- Agroforestry
- Habitat conservation
- Diversification of farm enterprises
- Introduction and integration of livestock enterprises

### **Crop Rotation**

- Crop rotation is one tool of diversification that is specifically required in the National Standard

- 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
- Crop Rotation = Diversity, which provides stability to biological systems
- Rotation breaks up disease, weed, and insect life cycles by spacing susceptible crops at intervals sufficient to hinder the buildup of their specific pest organisms

### **What the Organic Standard Says about Crop Rotation...**

The producer must implement a crop rotation including but not limited to sod, cover crops, green manure crops, and catch crops that provide the following functions that are applicable to the operation:

- Maintain or improve soil organic matter content;
- Provide for pest management in annual and perennial crops;
- Manage deficient or excess plant nutrients; and
- Provide erosion control.

### **Characteristics of Successful Crop Rotations**

- Include a crop sequence that features soil improving crops (sod crops, green manures, etc.) to counterbalance soil depleting crops (row crops)
- Include leguminous crops and cover crops
- Sequence crops to suppress insect pests, diseases, and weeds
- Include a mix of crops and cultural practices that minimize the duration of time that soil is bare
- Include 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

### **Soil Management**

They're making people every day, but they ain't makin' any more dirt. -- *Will Rogers*

- 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.

### **What the Organic Standard Says about Soil Management...**

- Select and implement tillage and cultivation practices that maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion.
- Manage crop nutrients and soil fertility through rotations, cover crops, and the application of plant and animal materials.
- Manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.

### **Organic Soil Management Practices**

- Well-designed crop rotations
- Optimum use of cover crops and green manures
- Use of mulches
- Composting or otherwise recycling on-farm manures and other wastes
- Good crop residue management
- Soil and water conservation practices
- Soil testing to address nutrient deficiencies
- Use of allowed fertilizers and soil amendments

### **Pest Management**

#### **Organic Pest Management – from ATTRA**

§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
    - sanitation measures to remove disease vectors, weed seeds, etc.
    - cultural practices such as resistant or tolerant varieties, timing of planting, etc.
  
- **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
    - mowing
    - grazing
    - cultivation and hand weeding
    - flame, heat, or electrical weeding
    - plastic mulches
  - Level B insect/animal pest control options include:
    - introducing or augmenting predators and parasites
    - developing habitat for beneficial predators and parasites
    - nonsynthetic lures, traps, and repellents
  - Level B crop disease control options include:
    - management practices (e.g. fire, flooding)
    - application of nonsynthetic biological, botanical, or mineral inputs
  
- **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. 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”.

### **What Products Can I Use in Organic Production?**

- National List of Allowed and Prohibited Substances
- Organic Materials Review Institute - OMRI

- Consult the Organic Certification Guide on the Growing Small Farms website for links: <http://chatham.ces.ncsu.edu/growingsmallfarms/orgcertguide.html>
- 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.

### **Weed Management**

- Sanitation
- Crop rotation
- Cover crops
- No-till production
- Intercropping
- Reducing weed seed bank
- Optimizing planting date
- Increasing crop competitiveness
- Proper water and nutrient management
- Stale seed bed
- Soil solarization
- Mechanical strategies – flaming, mowing, hoeing, tillage
- Biological control – herbivores, pathogens
- Approved herbicides?

### **Insect Management**

- Cultural Controls
  - Resistant cultivars
  - Crop rotation
  - Companion planting
  - Timing of planting
  - Sanitation

- Soil Management
  - Mulches
  - Composting
  - Tillage
  - Flaming
  - Trap crops
- Physical Controls
    - Manual controls
    - Physical barriers
    - Baits, traps, and lures
  - Biological Controls
    - Beneficial animals and insects
    - Beneficial microorganisms - Bt, milky spore, *Beauveria bassiana* (fungus), *Nosema* (protozoan)
  - Beneficial Organisms
 

Parasitoids: immatures develop on or inside a host, killing it as they mature; they emerge as adults and continue the cycle; examples include parasitic flies and wasps

Predators: larva or adult hunts, attacks, and consumes prey; examples include lady beetles, lacewings, praying mantids, syrphid flies, assassin bugs, minute pirate bugs, spiders, and predatory mites

Pathogens: colonize and kill host; examples include nematodes, bacteria, viruses, fungi and protozoa

Weed Feeders: weeds can be attacked by arthropods, vertebrates, and pathogens (fungi, viruses, bacteria, and nematodes)
  - Biological Control in Action
    - Augmentation – increase population through purchase and release
    - Conservation – increase existing populations through habitat conservation and other means
  - Organic Pesticides
    - When cultural, mechanical, and biological strategies are insufficient to prevent or control crop pests, weeds, or diseases, a biological or botanical substance or a substance included on the National List of synthetic substances allowed for use in organic crop production may be applied to prevent, suppress, or control pests, weeds, or diseases.
    - The conditions for using the substance must be documented in the organic system plan.
    - In other words, use them only as a last resort!

- Botanical pesticides
- Microbial pesticides
- Inorganic pesticides
  
- If you are certified organic, always check with your certifying agency before applying a pesticide!

## **Diseases**

- Address the Three Conditions Required for Pathogens
  1. Susceptible host plant – avoid with resistant and tolerant cultivars, crop rotation
  2. Presence of inoculum – reduce through sanitation
  3. Environmental conditions – limit with cultural practices
  
- Site Selection Considerations
  - Soil type and associated drainage patterns
  - Field layout and exposure
  - Soil compaction
  
- Plan for Diversity over Time
  - Rotation - soil inhabitant or soil invader
  - Crop-free periods - obligate parasites
  - Sowing dates and harvest time can be adjusted
  
- Plan for Diversity over Space
  - Use variety mixtures
  - Employ intercropping
  
- Plan for Genetic Diversity
  - Host plants
  - Soil microbial communities
  - Use of cover crops, no-till
  
- Exclusion and Evasion
  - Use of plant quarantines
  - Don't import diseases on seeds or in soil
  - Control weeds and alternative hosts
  - Evade problems by growing seed plants in areas of low or no disease pressure for that particular plant

- Variety Selection
  - Disease resistance vs. disease tolerance
  - Select cultivars that have disease resistance/tolerance characteristics that are appropriate for your climate
  - Local/regional heirloom varieties have often evolved with particular disease-resistant characteristics
  - Keep good records of a cultivar's performance and the disease pressure for each season
  
- Sanitation to Reduce Inoculum
  - Start with clean seed
  - Hot water treatment
  - Disease-tested certified seed
  
- Transplant Production
  - Buy from a reputable producer
  - Use clean, sterile containers and growing structures
  - Use soilless mix
  - Provide good air movement, temperature control and optimal germinating conditions
  - Keep seedling flats up off the ground avoiding contact with soil-borne pathogens
  
- General Strategies
  - Rogue isolated infected plants from the field during the growing season
  - Increase air movement by staking, pruning, and using wide-row spacing
  - Use drip irrigation to minimize leaf wetness period
  - Use mulch to prevent soil splashing onto foliage and fruit
  - Avoid working in the garden when foliage is wet to reduce the spread of inoculum
  - Use raised beds to improve drainage
  - Cultivate carefully to promote healthy root growth
  - Use floating row covers and reflective mulches to reduce insect vector activity
  - Harvest gently to minimize cuts and bruises on the produce
  - Cool produce rapidly after harvest to slow microbial activity; store at cool temperatures
  - Optimize NPK fertility to reduce stress
  - Rotate crops and incorporate crop residues to reduce inoculum buildup
  - Plow, disk or roto-till immediately after harvest to speed up the decomposition of plant tissue
  - Wash equipment frequently to reduce the spread of inoculum

### **Resources for Organic Production**

- Visit NC Cooperative Extension's Growing Small Farms website:  
<http://chatham.ces.ncsu.edu/growingsmallfarms>

- Info on production, marketing, pest management, resources, certification, etc.  
– over 300 pages!
- The Grower Resource List includes books, sources for organic seeds, equipment, fertilizers, plants, season extension, and more
- Rodale's The New Farm - <http://www.newfarm.org> – lots of info on organic, no—till, organic price index, and much more
- ATTRA - <http://attra.ncat.org> – lots of articles on organic production
- Southern SAWG - <http://www.ssawg.org> – fantastic annual conference in January with lots of info on organic production, marketing, business management, etc.
- Organic Farming Research Foundation - <http://www.ofrf.org>
- SARE - <http://www.sare.org> – publications, grants, etc.