• Organic Soil Fertility: The basics
• Crop Rotations
• Cover Crops
• Manure & Compost
• Livestock Standards
• Approved & Prohibited Substances
• Organic Nutrient Application and Planning
What is Organic Agriculture?

- **The production of crops and animals without the use of synthetic pesticides or fertilizers.**

- “An organic farm, properly speaking is not one that uses certain substances and avoids others; it is a farm whose structure is formed in imitation of the structure of a natural system; it has the integrity, the independence, and the benign dependence of an organism.”

  - Wendell Berry
NOP Definition of “Organic Production”

- **Positive definition:** ‘A production system that is managed . . . by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity’ (7 CFR 205.2)

  “…maintain or improve soil and water quality…”

- **Negative definition:** Food produced and handled without synthetic substances (with specific, limited, well-defined exceptions), and excludes genetically modified organisms, sewage sludge, and irradiation (7 CFR 205.105)

-- Organic Food Production Act, 1990
Related NOP Requirements

- Organic System Plan
- Recordkeeping
- § 205.200 Production practices ... must maintain or improve the natural resources of the operation, including soil and water quality.

Anyone know what this is?
(a) maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion.

(b) rotations, cover crops, and the application of plant and animal materials.

(c) manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination...

(d) manage crop nutrients and soil fertility to maintain or improve soil organic matter content in a manner that does not contribute to contamination ...

(e) The producer must not use: Prohibited substances
Organic Soil Fertility

- One component of integrated farm plan
- Relies on biological processes
- What does this mean?
  - “Feed the soil so that the soil can feed the plants”
  - Moisture, temp., tillage, N levels all affect decomposition and mineralization
  - Crop and animal residues do not afford precise nutrient management (exact amount at exact time)
Soil ‘Livestock’

- Fix atmospheric N
- Promote decomposition of OM so that nutrients are available to plants
  - PAN is released from OM through mineralization
- Mycorrhiza develop symbiotic relationships with roots to extend reach
- Produce microbial polymers that contribute to soil aggregation
Why do stable soil aggregates matter?

- Improved water and nutrient holding capacity
- Improved infiltration
- Improved aeration
- Improved tilth and soil structure
- Deeper/healthier roots
- Easier tillage
- Decreased crusting & clodding
- Decreased erosion
The producer must select and implement tillage and cultivation practices that maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion.

- **Reduce soil disturbance:**
  - Minimum till & mulch till
  - Flame weeding
  - Choosing appropriate environmental and soil conditions

- **Build soil organic matter:**
  - Mulch
  - Cover crop
  - Crop rotations
  - Compost & manures

Organics biggest challenge!
(b) The producer must manage crop nutrients and soil fertility through rotations, cover crops, and the application of plant and animal materials.
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.
Real Fields on Real Farms:

This page is from Crop Rotation on Organic Farms: A Planning Manual, NRAES 177. To purchase the book, visit www.nraes.org or www.sare.org, or call (607) 255 7654. The first page of this PDF has information on fair use.

<table>
<thead>
<tr>
<th>Year</th>
<th>One Straw Farm</th>
<th>Pleasant Valley Farm</th>
<th>Riverbank Farm</th>
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<td>Y1</td>
<td>Winter</td>
<td>Mulch</td>
<td>Hay</td>
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<td>Spring</td>
<td>Lettuce</td>
<td>Buckwheat</td>
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<td>Summer</td>
<td>Beans</td>
<td>Oats</td>
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<td></td>
<td>Winter</td>
<td>Winter Rye</td>
<td>Carrots</td>
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<tr>
<td></td>
<td>Crimson Clover</td>
<td>Radish</td>
<td>Multiple Crops</td>
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<tr>
<td>Y2</td>
<td>Spring</td>
<td>Winter Rye</td>
<td>In Strips:</td>
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<tr>
<td></td>
<td>Summer</td>
<td>Carrots</td>
<td>Onions/Spinach/</td>
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<td></td>
<td>Fall</td>
<td>Turnips</td>
<td>Beets/Radish/</td>
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<td></td>
<td>Winter</td>
<td>Rye</td>
<td>Salad Mix</td>
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<td>Rye - Vetch</td>
<td>Rye</td>
<td>Lettuce/Peas</td>
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<td>Y3</td>
<td>Spring</td>
<td>Lettuce</td>
<td>Carrots</td>
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<td>Summer</td>
<td>Winter Squash</td>
<td>Beets</td>
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<td>Fall</td>
<td>(with hay mulch)</td>
<td>Lettuce</td>
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<tr>
<td></td>
<td>Winter</td>
<td>Mulch</td>
<td>Tomato/Pepper</td>
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</table>

**KEY**
- "Fallow" indicates a deliberate period of bare soil, often with frequent cultivation to kill weeds.
- Split boxes indicate strip crops or split beds.
- Interwoods and crops from more than one family are represented by a dark gray background.
- Cash crops are indicated by black text, cover crops and fallows by white text.

The boxes below show the color codes for plant families in the rotation diagrams.

Harvest of brassica and fall cool-season crops extends into winter. Crops may be interseeded at the last cultivation.
Organic Cover Cropping

- **Common Types**
  - Higher seeding rates - up to 50% +

<table>
<thead>
<tr>
<th>Species</th>
<th>Dry Matter (T/A)</th>
<th>Total N (lb/A)</th>
<th>PAN (lb/A)</th>
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</thead>
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<td>Hairy vetch</td>
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<td>Common vetch</td>
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<td>Sub clover</td>
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<td>115</td>
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<td>Crimson clover</td>
<td>3</td>
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<td>Field pea</td>
<td>1.7</td>
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<tr>
<td>Red clover</td>
<td>1.7</td>
<td>85</td>
<td>50%</td>
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<td>Rape seed</td>
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<td>Small grains</td>
<td>2-3</td>
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<td>Annual rye grass</td>
<td>3</td>
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<td>Cereal rye</td>
<td>2-3+</td>
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<tr>
<td>Sudhan grass</td>
<td>Very high!</td>
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<td>?</td>
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</tbody>
</table>

*Varies based on % legumes, maturity, and other factors*
Organic Cover Cropping

- **Mixes/cocktails**
  - Combine multiple benefits
  - Increase diversity and habitat
  - Grasses immobilize or release small amounts of N: -5%-20% PAN
  - Legumes have 30-50% PAN

- **Sources**
  - Organic v. Non-Organic Seed
    - Commercial Availability

IA NRCS, Wells Dairy
Aerial applied wheat and red clover into organic soybeans for weed control and winter cover.
Additional Cover Crop Considerations

- Prevent leaching and runoff!
- Complexity of N release
- Pest & Disease Management
- Weed Management
- Allelopathy
(c) The producer must manage plant and animal materials to maintain or improve soil OM content in a manner that does not contribute to contamination.

Animal and plant materials include:

- Raw animal manure
- Composted plant and animal materials
- Un-composted plant materials.
Raw animal manure

- Must be composted unless it is:
  - Applied to land used for a crop not intended for human consumption
  - Incorporated into the soil not less than ___ days prior to harvest
    - 90: edible portion doesn’t have direct contact with the soil
    - 120: direct contact with soil

Processed manures can also be used until the day of harvest with documentation of that it has reached 165F or 150F for one hour.
Compost

- NOP regulation defines compost as a process that:
  - Established an initial C:N ratio of between 25:1 and 40:1
  - Maintained between 131 °F and 170 °F for
    - 3 days using an in-vessel or static aerated pile system; OR
    - 15 days using a windrow composting system, during which period, the materials must be turned a minimum of five times.
  - The pH value of finished compost is usually 6.5-7.5. At pH values below 7.5, N remains in the ammonium form and is not subject to loss as ammonia gas. - OSU EM 8954-E
More on Manure & Livestock

- Organic v. Conventional Manure
  - Contamination
- Origin of Livestock
- Livestock feed
- Health care
- Living Conditions
- Pasture
Organic Livestock Living Conditions

- (a) The producer of an organic livestock operation must establish and maintain year-round livestock living conditions which accommodate the health and natural behavior of animals, including:
  
  1. **Year-round access for all animals to the outdoors**, shade, shelter, exercise areas, **fresh air**, clean water for drinking, and **direct sunlight**, suitable to the species, its stage of life, the climate, and the environment. Yards, feeding pads, and feedlots may be used to provide ruminants with access to the outdoors during the non-grazing season and supplemental feeding during the grazing season. Yards, feeding pads, and feedlots shall be large enough to allow all ruminant livestock occupying the yard, feeding pad, or feedlot to feed simultaneously without crowding and without competition for food. **Continuous total confinement of any animal indoors is prohibited. Continuous total confinement of ruminants in yards, feeding pads, and feedlots is prohibited.**

- It does not currently say access to soil or give stocking densities.
Concerns?

- Effects on the current CNMPs when animals are “confined” in covered free-stall barns for 4 months a year
  - (b) The producer of an organic livestock operation may provide temporary confinement or shelter for an animal because of:
    - (1) Inclement weather;
    - (4) Risk to soil or water quality;
  - Oregon Tilth allows free stall barns with open sides because there has been no further clarification on the definition of "outdoor access". Animals must have fresh air and access to direct sunlight. This could vary by certifier and can change if additional guidance from the NOP is released.
Concerns?

- The need to comply with outdoor loafing areas accessible for an undefined period of time, in any kind of weather.
  - Producers can opt to build an uncovered concrete outdoor area with an enclosed barn for temporary confinement during inclement weather, assuming it meets the standards.
- Producers need to be complaint with this rule by June of 2011
- NOSB meeting in April for feedback
Organic Livestock Living Conditions

(a) The producer of an organic livestock operation must establish and maintain year-round livestock living conditions which accommodate the health and natural behavior of animals, including:

- Pasture requirements
- Appropriate clean, dry bedding. When roughages are used as bedding, they must be organic.
- Shelter
- The use of yards, feeding pads, feedlots and laneways that shall be well-drained, kept in good condition, and managed to prevent runoff and contamination.
(d) A producer may manage crop nutrients and soil fertility to maintain or improve soil OM content in a manner that does not contribute to contamination . . . by applying ‘APPROVED substances’.

- Review § 205.203 (d) 1-5
- In other words, synthetic materials cannot be used unless they are specifically approved, and natural materials can be used unless they are specifically prohibited.
- ‘Prohibited substances’ also include: sewage sludge, GMOs, treated lumber, and burning as a means of disposal for crop residues produced on the operation:
  - Except, That, burning may be used to suppress the spread of disease or to stimulate seed germination.
Where can you look for approved substances?

- Third party sources that review materials for compliance with the NOP regulation:
  - OMRI, Organic Materials Review Institute
    [http://www.omri.org/home](http://www.omri.org/home)
  - WSDA Materials List
Where can you look for approved substances?
Where can you look for approved substances?

Generic Materials Search: straw

2 results
2 items found.

View the OMRI Generic Materials List Glossary in PDF format [here].
Click on the arrow or the material name to view more details about each material.

- Plants
- Straw

Status: Allowed
Class: Crop Fertilizers and Soil Amendments, Crop Pest, Weed, and Disease Control
Origin: Nonsynthetic
Description: May be from nonorganic sources. Must be from nongenetically modified plants.
NCP Rule: 205.203(c)(3) Uncomposted plant materials.
Common Organic Nutrient Sources

- **Organic Matter is #1**
- **Nitrogen**
  - Blood meal (12-0-0) Made from slaughterhouse waste and is one of the highest non-synthetic N sources.
  - Feather meal (7-12% N) Sourced from poultry industry, has relatively high N but is lower release.
  - Fish meal (10-6-2) Ground and heat dried fish waste.
  - Seed meals- Soy, cotton, flax (ranges 6-8% N) Can be sourced from GMOs and have substantial pesticide residue.
  - Alfalfa meal (2-1-2) Primarily for OM and trace minerals.
- **Phosphorous**
  - Bone meal (3-15-0)
- **Potassium**
  - Greensand (0-0-3) Mined from the ocean floor with up to 30 trace minerals.
- **Other**
  - Kelp- Trace mineral source
How do you calculate organic nutrients?
Soil & Tissue Testing

- Beyond mineral composition
  - OM & PAN but cannot predict how much organic N will mineralize
  - Measuring N mineralization through crop N uptake
  - Biological assessments
  - Organic/alternative minded labs
- Using LGU labs
Measuring Soil Biology

The Soil Food Web

- **Nematodes** (Root-feeders)
  - Fungal and bacterial feeders
- **Arthropods** (Shredders)
  - Fungal and bacterial feeders
- **Fungi** (Mycorrhizal fungi, Saprophytic fungi)
  - Shredders, Предатели
- **Plants** (Shoots and roots)
  - Waste, residue, and metabolites from plants, animals, and microbes
- **Organic Matter**
  - Plants, Animals, and Bacteria
- **Protozoa** (Amoebae, flagellates, and ciliates)
  - Shredders, Predators
- **Bacteria**
  - Root-feeders
- **Arthropods** (Predators)
  - Higher level predators
- **Birds**
  - Higher level predators
- **Animals**
  - Higher level predators

First trophic level: Photosynthesizers
Second trophic level: Decomposers, Mutualists, Pathogens, parasites, Root-feeders
Third trophic level: Shredders, Predators, Grazers
Fourth trophic level: Higher level predators
Fifth and higher trophic levels: Higher level predators

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info@oregonfoodweb.com
Cumulative Available N from an Organic Source

Year 1

After 5+ yr of consistent organic inputs you approach equilibrium

N into soil = available N

Courtesy of Dan M. Sullivan, Crop & Soil Science, OSU
Calculating Organic Nutrient Applications

Enter FERTILIZER ANALYSES & SEE FERTILIZER, COMPOST AND COVER CROP PAN ESTIMATES

Enter your information in yellow cells. Results are in green cells.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Total % N from label (&quot;as-is&quot; basis; % of product)</th>
<th>Total % dry matter (% of product)</th>
<th>%PAN at 28 days (% of amendment total N, dry wt basis)</th>
<th>%PAN after full season (% of amendment total N, dry wt basis)</th>
<th>PAN at 28 days (lb N per 100lb amendment &quot;as-is&quot; basis)</th>
<th>PAN after full season (lb N per 100lb amendment &quot;as-is&quot; basis)</th>
<th>P\textsubscript{2}O\textsubscript{5} (%)</th>
<th>K\textsubscript{2}O (%)</th>
<th>Ca (%)</th>
<th>Mg (%)</th>
<th>S (%)</th>
<th>B (%)</th>
<th>Cu (%)</th>
<th>Fe (%)</th>
<th>Mn (%)</th>
<th>Zn (%)</th>
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<td>12.5</td>
<td>91</td>
<td>60</td>
<td>75</td>
<td>7.50</td>
<td>9.38</td>
<td>1.5</td>
<td>0.6</td>
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<td>75</td>
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Calculating Organic Nutrient Applications

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<thead>
<tr>
<th>MATERIAL</th>
<th>APP’N RATE Description</th>
<th>Total N Applied (lb/ac)</th>
<th>Total dry matter applied (lb/ac)</th>
<th>Estimated PAN after 28 days (lb/ac)</th>
<th>Estimated PAN after full season (lb/ac)</th>
<th>P2O5 (lb/ac)</th>
<th>K2O (lb/ac)</th>
<th>Ca (lb/ac)</th>
<th>Mg (lb/ac)</th>
<th>S (lb/ac)</th>
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<td>Meat and bone meal (7-8-0)</td>
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<td>Soy meal (6.5-1.5-2.4)</td>
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<td>Sulfate of potash (0-0-50)</td>
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<td>Sulfate of potash magnesia (0-0-22)</td>
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How do we know if it works?

Pass

Fail

Rodale Institute Farming Systems Trials, Rodale.org
What to check?

- Soil quality - aggregate stability, OM, microbial activity
- Crop health & yields
- Disease & pest levels
- Water quality
- Erosion

If one of these is off then the system is out of balance...

**Figure 6.14** Mean corn yields in drought years (1988, 1994, 1995, 1997, 1998) in the Rodale Institute Farming Systems Trial. Different letters above bars denote statistical differences ($p = 0.05$).
Organic Nutrient Management Results

• 9-year annual cropping trials, with tillage; no pasture systems

• (MD, PA, OH, IA, WI, MI, CA)

Organic mgt. led to:

● Soil POM C, N  +30-40%
● SOC ave. 10 yr  +14%
● Legume based system similar to manure based

MLO  manure organic
LO   legume organic
CV   conventional

Courtesy of David Granatstein, Washington State University
Considerations for 590 Scenarios

- **Complexity of Operation**
  - Scale, diversity of rotation, # of crops
  - Management level
    - Cover crops, on-farm compost, foliar feeding, rotation intensity
Questions?

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503-273-2433

Resources


Organic Cover Crop & Fertilizer Calculator
http://smallfarms.oregonstate.edu/calculator

eOrganic
www.extension.org/organic_production

ATTRA
www.attra.ncat.org

Rodale
www.rodaleinstitute.org