

**NEED TO KNOW  
INFORMATION FOR ORGANIC  
CROP PRODUCTION**

# What Does “Organic” Mean

- A production system that “respond[s] to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity”
- A production system that meets all the requirements of the National Organic Program Regulations



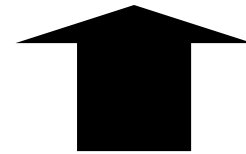
# What's Required

- An interest in environmentally friendly farming
- Willingness to conform to a standard
- Designated acreage
- 3-year conversion i.e. no prohibited materials applied

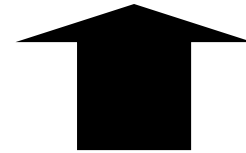
# Organic History & Philosophy

- Began in the 1920s in Europe as an alternative to a wide array of farm problems
- Soil-based system emphasizing soil humus (腐殖质) management

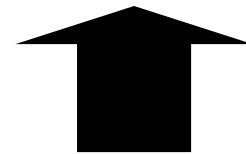
HEALTHY SOCIETY



HEALTHY PEOPLE



HEALTHY FOOD



HEALTHY SOIL

# **MYTH**

**Organic Farming is simply  
agriculture as it was practiced  
before the era of commercial  
agricultural chemicals**

# **REALITY**

**Organic Farming is a deliberate approach to farming based on regeneration and the promotion of life and health in the soil**

**Organic Farming employs many traditional strategies—such as crop rotation, green manuring (绿肥), composting (堆肥), and fertilizing with organic wastes—**

**that serve as cornerstone practices for sustainable agricultural systems**

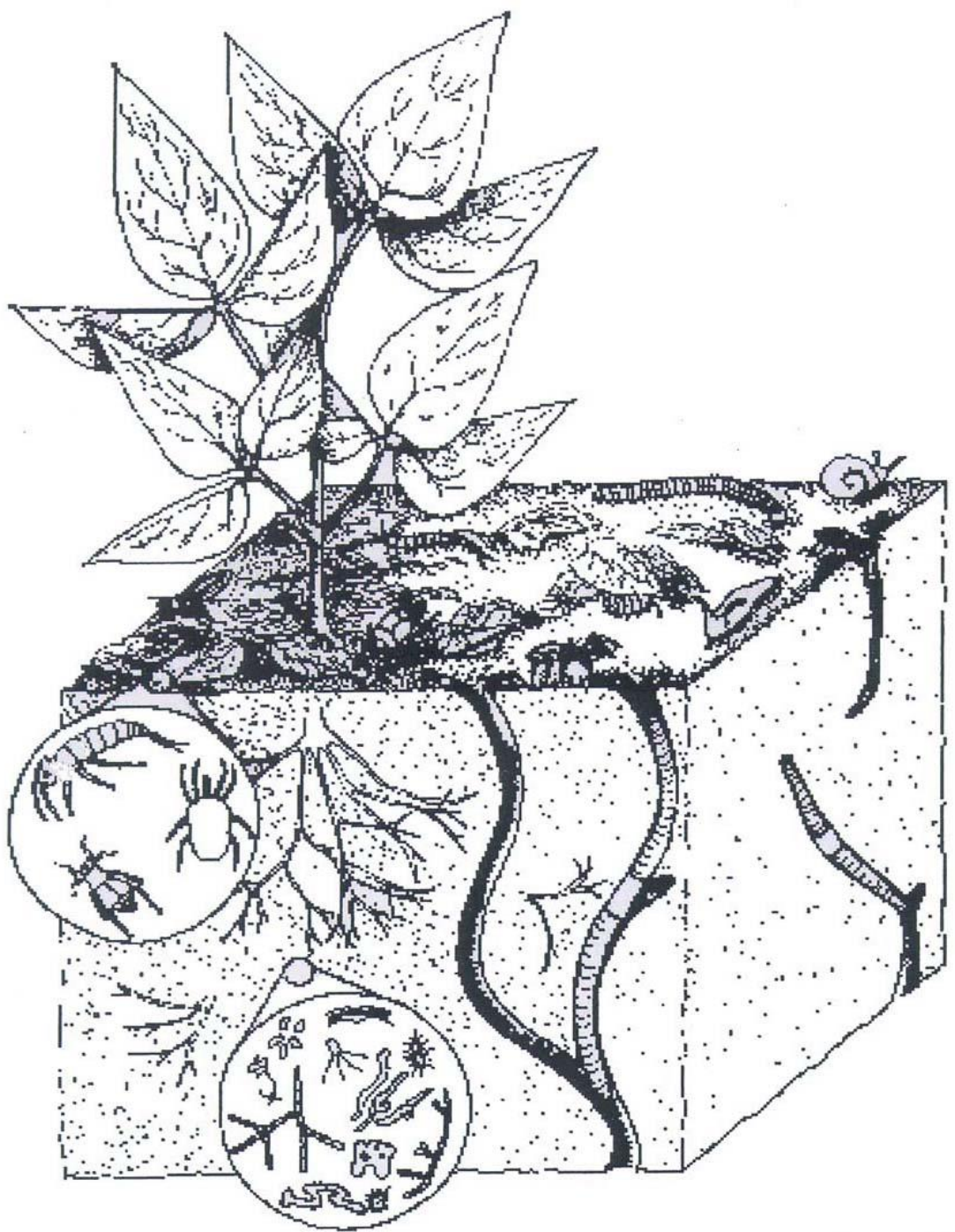
**The use of regenerative  
soil building practices  
and the maintenance of  
biodiversity makes  
most conventional  
pesticides and fertilizers  
unnecessary and even  
counterproductive**

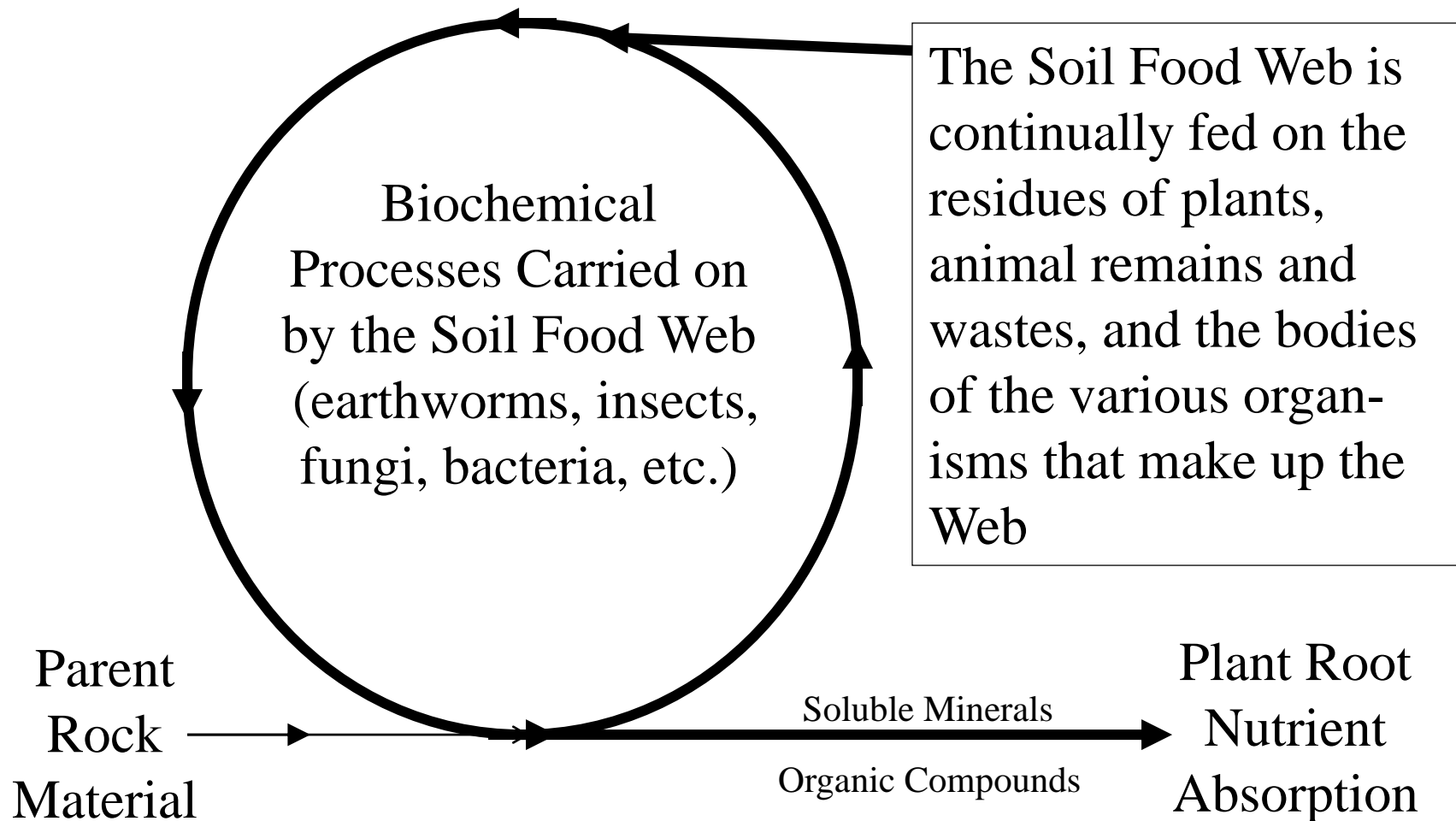


# ***Feed The Soil, Not The Plant***

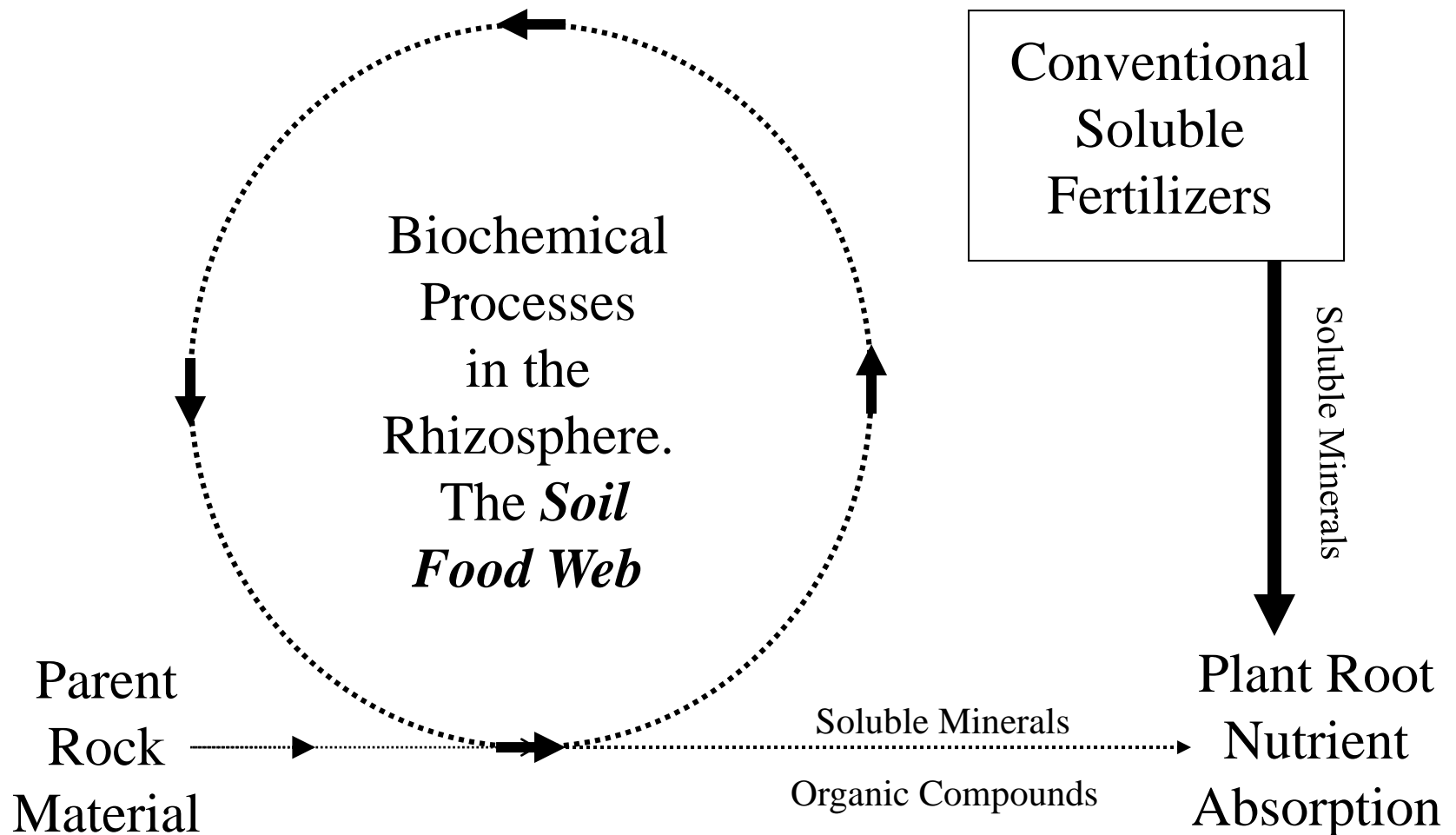
**— An Old Saying Among Organic Farmers**

# The Soil Food Web

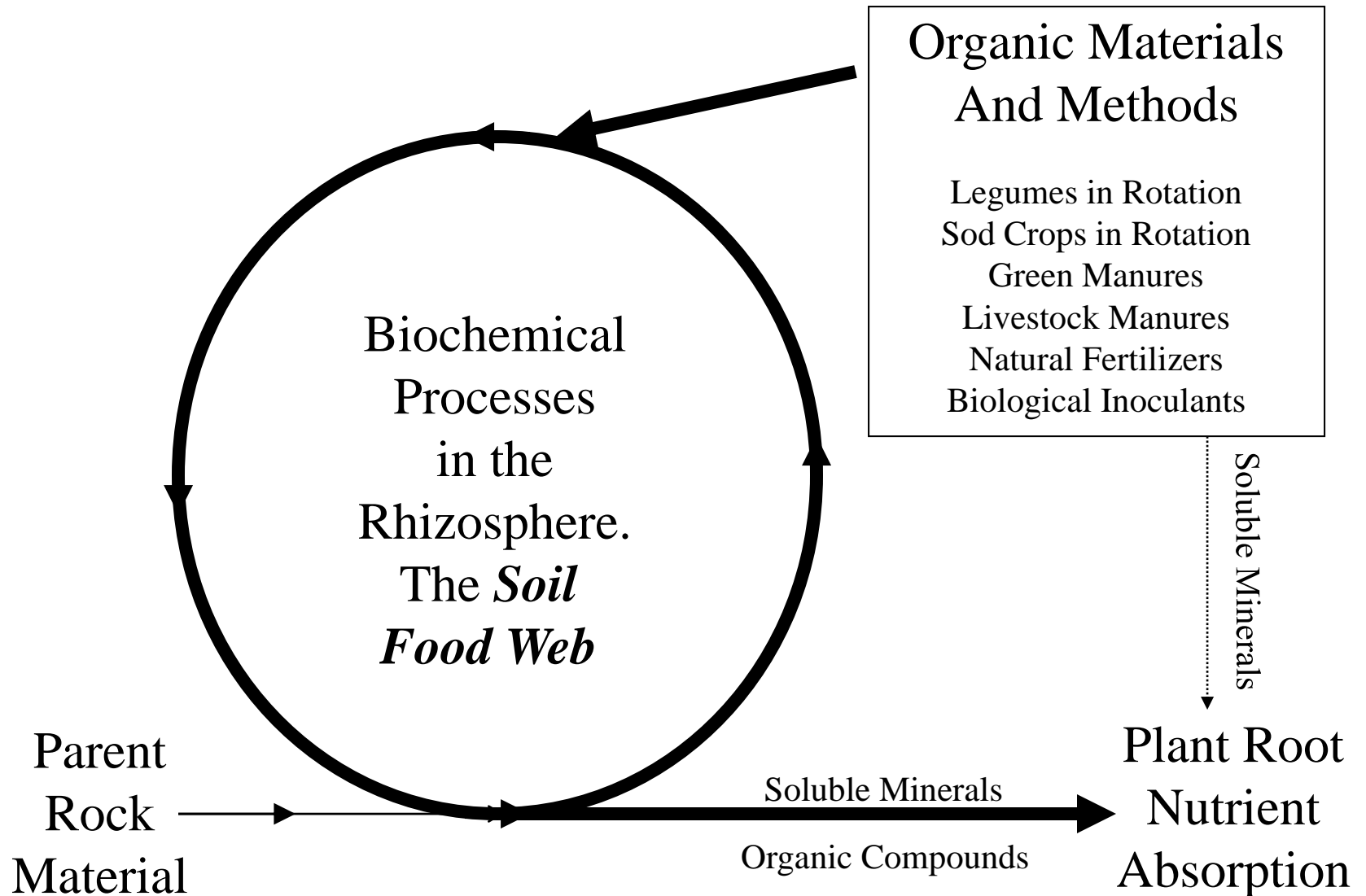




## Plant Nutrition Under Natural Conditions



## Conventional Approach To Plant Nutrition



## Organic Approach To Plant Nutrition

# The Two Faces of Organic Farming

- A Biologically-based Production System based on Natural Principles and Demonstrating a High Degree of Sustainability
- A System that Preserves the Integrity of Organic Production from Contamination with Prohibited Substances and Commingling with Non-Organic Products

# Soil Fertility Practices for Organic Farming

- Crop Rotation Specifically Required §205.205
- Cover Crops & Green Manures
- Composts (堆肥) and Manures (粪肥)
- Monitor & Provide Adequate Minerals
- Supplementary Organic Fertilizers

# Cover Crops

Cover crops are grasses, legumes, and other forbs (杂类草) that are planted for erosion control, improving soil structure, moisture, and nutrient content, increasing beneficial soil biota (生物群), suppressing weeds, providing habitat for beneficial predatory insects, facilitating crop pollinators, providing wildlife habitat, and as forage for farm animals. Furthermore, cover crops can provide energy savings both by adding nitrogen to the soil and making more soil nutrients available, thereby reducing the need to apply fertilizer.



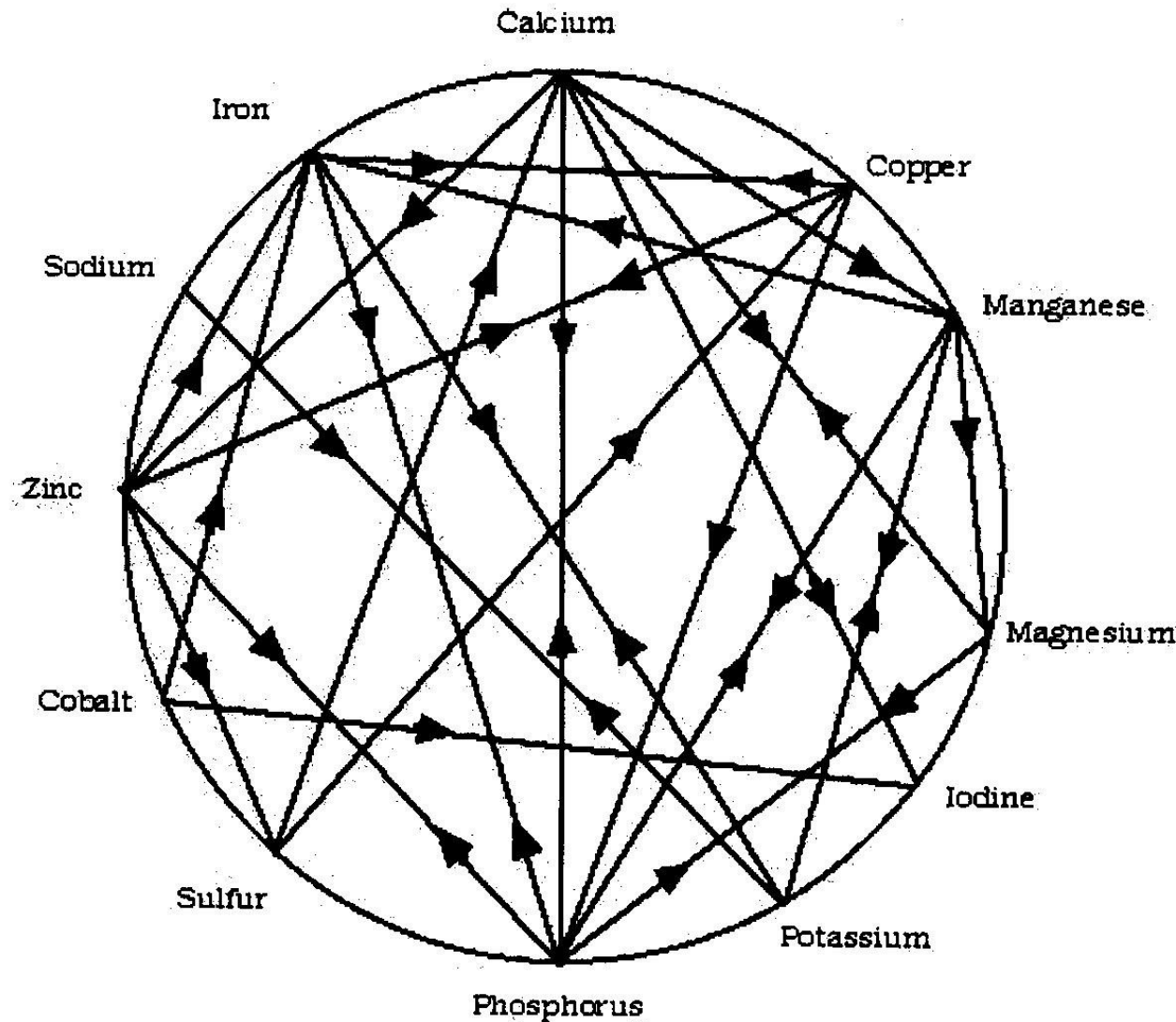
# Green Manures

Green manures are plants which are grown to benefit the soil. Green manures are the organic way to

- improve the soil fertility, including adding valuable nitrogen
- improve the soil structure, giving better drainage or water retention
- suppress weeds
- attract beneficial insects and other predators

These plants are quick growing, so the process is simple. You sow, they grow - and then you dig them in. In just a few weeks green manures can benefit the soil.

# THE MINERAL WHEEL



# Compost Rules

## For Manure-Based Compost

- Initial feedstock mix must have a C:N ratio between 25:1 and 40:1 [§205.203(c)(2)(i)]

# Manure Rules

## When Applied to Food Crops

- Uncomposted manure must be applied and incorporated not less than 120 days prior to the harvest of a crop whose edible portion has direct soil contact (i.e. most vegetable crops)  
[§205.203(c)(1)(ii)]
- Uncomposted manure must be applied and incorporated not less than 90 days prior to the harvest of a crop whose edible portion does not have direct soil contact [§205.203(c)(1)(ii)]

# Soil Amendments and Fertilizers: What You May **Not** Use

## Prohibited

- Most conventional fertilizers
- Biosolids (sewage sludge) [§205.105(g)]
- Ash from manure burning [§205.602(a)]
- Contaminated organic materials (leather meal, cottonseed meal, & poultry litter ( 家禽 粪便 ) are often suspect)
- GMO soil inoculants

# Soil Amendments, Fertilizers, & Compost Feedstock: What You **May** Use

## Natural Materials

- Manures
- Plant materials (residues, seed meals, kelp (海藻) meal)
- Animal by-products (bone meal, blood meal)
- Natural rock powders (aglime, rock phosphate, greensand, gypsum, granite meal, K-Mag®, potassium sulfate)
- Wood ash

# Soil Amendments, Fertilizers, & Compost Feedstock: What You **May** Use

## Synthetic Materials [§205.601]

- Liquid fish products (some commercial forms)
- Seaweed extracts (some commercial forms)
- Humic acids ( 腐殖酸 some commercial forms)
- Elemental sulfur

# Soil Amendments, Fertilizers, & Compost Feedstock: What You **May** Use

## Restricted Materials

- **Micronutrients** (微量元素 soluble boron, sulfates, carbonates, oxides, silicates, and lignon sulfonate chelates. Deficiency must be documented) [§205.601(j)(6)]
- **Sodium nitrate** (硝酸钠 no more than 20% of crop's total nitrate requirement) [§205.602(h)]
- **Potassium chloride** (氯化钾 mined source only; no chloride accumulation) [§205.602(g)]



# Organic Strategy For Weed & Pest Management

- I. Organic System Effects
- II. Traditional Organic Practices
- III. Allowed Pesticides

# I. Organic System Effects On Pests

- Systemic Practices:

rotation, cover cropping, organic fertilization, adapted and resistant cultivars, composting and basic sanitation practices

- Systemic Effects:

- innate and induced resistance/tolerance
- biocontrol of pests and diseases in the soil
- biocontrol of above ground pests
- life cycles of weeds and pests disrupted
- weed seedbank reduced
- beneficial shift in weed populations

## II. Traditional Organic Pest Control Practices

### Weeds

- cultivation
- organic mulches
- Mowing (割草)
- grazing (放牧)
- weeder geese
- handweeding
- flame weeding
- plastic mulch

### Insects & Disease

- beneficial habitats
- augmentation of beneficials
- physical barriers
- nonsynthetic lures (诱捕剂), traps, repellents (驱虫剂)
- adjusting timing

# mulches

Mulch is any material that is spread or laid over the surface of the soil as a covering. It is used to retain moisture in the soil, suppress weeds, keep the soil cool, and make the garden bed look more attractive. Organic mulches also help improve the soil's fertility, as they decompose.

## Types of Organic Mulch

- Bark, Shredded or Chipped
- Compost
- Composted Manure
- Grass Clippings
- Newspaper
- Shredded Leaves
- Straw

# Why Get Weeding Geese?

- With weeding geese, farmers and gardeners can use fewer herbicides. Using fewer herbicides may save money and time.
- Geese can weed in the rain, and can weed all day (do you have time to weed all day?).
- Geese have a lighter footprint than humans or equipment and heavy machinery. This means less compaction on soil structure, and the ability to work on wet soils where humans or machinery should not work on when wet.
- Weeder geese can clean ditches and other hard-to-access areas that are awkward for equipment.
- Weeding geese fertilize the soil with their droppings as they work.
- Best of all: **geese lay awesome eggs.**
- Finally, geese are good at letting you know someone has arrived on your property.

# III. Allowed Pesticides

- Naturals (nonsynthetics)
  - minerals (diatomaceous earth, baking soda)
  - biologicals (*Bt*, *B. bassiana*)
  - botanicals (rotenone 鱼藤酮, neem 印楝素, pyrethrum 除虫菊酯)
- Synthetics (on the National List only)
  - minerals (sulfur, copper)
  - soaps (insecticidal, herbicidal)
  - horticultural oils (narrow range, superior)
  - Pheromones ( 信息素 )

## What is *Bacillus Thuringiensis* (苏云金杆菌)?

*Bacillus thuringiensis* (Bt) is actually a naturally occurring bacterium, common in some soils, that causes disease in certain insects, most notably leaf and needle feeding caterpillars. It was first discovered in the early 1900s. The French were the first to advocate using Bt in the garden and by the 1960s, *Bacillus thuringiensis* products were available on the open market and were readily embraced by the organic gardening community.

Controlling pests with *Bacillus thuringiensis* is dependent on its active ingredient, a crystal protein, which paralyzes the digestive system of the insect. The infected insect stops feeding and starves to death. While the original strains of Bt pest control were directed at caterpillars such as tomato hornworms, corn borers or earworms, cabbage loopers and leaf rollers, new strains have been developed to attack certain flies and mosquitoes. *Bacillus thuringiensis* products have become an essential weapon in the battle against West Nile Virus. Some field crops, such as corn and cotton, have been genetically altered to contain the gene for the crystal protein in their plant structure.

All in all, controlling pests with *Bacillus thuringiensis* has become a marvelous tool.

## Controlling Pests with *Bacillus Thuringiensis*

**Now that you have the answer to what is *Bacillus thuringiensis*, it probably sounds like Bt pest control is the only way to go, but there are a few things you should know about *Bacillus thuringiensis* products before you begin.**

**First and foremost, read the label. You don't need to use Bt in the garden if you don't have the pests it eliminates. *Bacillus thuringiensis* products are very specific in the insects they will or won't kill. As with any pesticide – man-made or natural – there is always the danger of insects becoming immune and you don't want to add to that problem with overuse.**

**Secondly, Bt will only affect those insects that actually eat it, so spraying your corn crop after the larvae have made their way inside the ear will be of little use. Timing is crucial, so the observant gardener won't try to spray the moths or eggs, only the leaves the larvae will eat. For those specified insects that do ingest the Bt product, be aware that starvation can take days. Many gardeners who have previously applied only chemical pesticides are used to the immediate effects on insect's nervous systems and, therefore, think Bt pest control doesn't work when they see the insects still moving.**



**Bacillus thuringiensis products are highly susceptible to degradation by sunlight, so the best time to spray your garden is early morning or evening. Most of these products adhere to the foliage for less than a week following application and the period shortens with rain or overhead watering.**

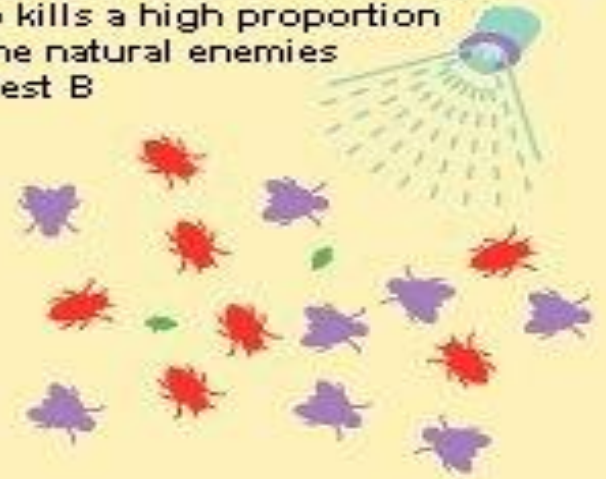
**Bt pest control products have a shorter shelf life than most chemical insecticides and should be stored in a cool, dark place. It's best to buy no more than can be used in a single season, although manufacturers generally claim a reduction in effectiveness after two to three years. The timeline for liquid applications is even shorter.**

**If your garden is bothered by any of the susceptible insects, Bt pest control might be something to consider. Controlling pests with Bacillus thuringiensis can be an effective and environmentally friendly way to treat your garden. Knowing about what Bacillus thuringiensis is and how and when it should be used is the key to its success.**

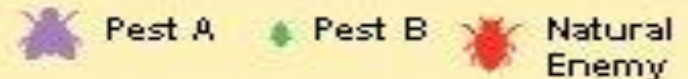
**pesticide treadmill** is a term indicating a situation in which it becomes necessary for a farmer to continue using **pesticides** regularly because they have become an indispensable part of an agricultural cycle.

# Pesticide Treadmill A: Secondary Pest Problems

Secondary pests are created when a pesticide applied to control Pest A also kills a high proportion of the natural enemies of Pest B



Without natural enemies, the population of Pest B increases to where it becomes a problem



# Pesticide Treadmill B: Resistance

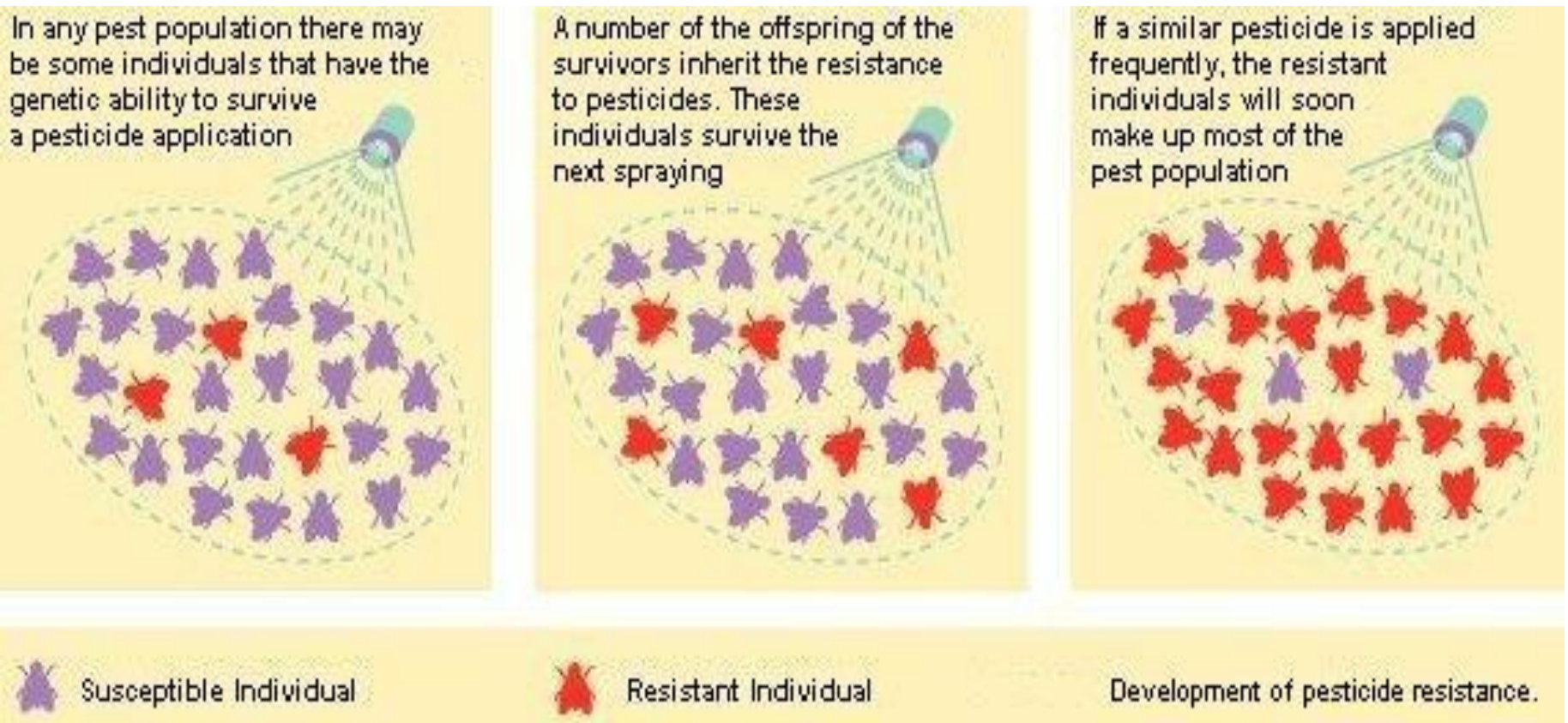


Figure from: *Best Management Practices: Horticultural Crops*, <http://www.gov.on.ca/OMAFRA/english/environment/hort/basics3.htm>

# Seed And Planting Stock

- Organic seed and planting stock must be used  
[§205.204(a)]
- If not commercially available, untreated seed or planting stock may be used; no GMOs  
[§205.204(a)(1)]
- Conventional seed treatments are prohibited, unless required by Federal or State regulations  
[§205.204(a)(5)]
- Organic transplants must be used [§205.204(a)]

# Seed And Planting Stock: Avoiding the Pitfalls

- Organic requirements apply to cover crops
- Seed for sprouting *MUST* be organic [§205.204(a)(1)]
- Inoculants must be non-GE
- Perennial planting stock—consult your certifier  
[§205.204(a)(4)] has tricky language

# Wild Crop Harvesting [§205.207]

- Harvest area must be:
  - Designated
  - Protected from contamination
  - Free of prohibited substances for 3 years
- Harvesting must be:
  - Sustainable
  - Environmentally sound

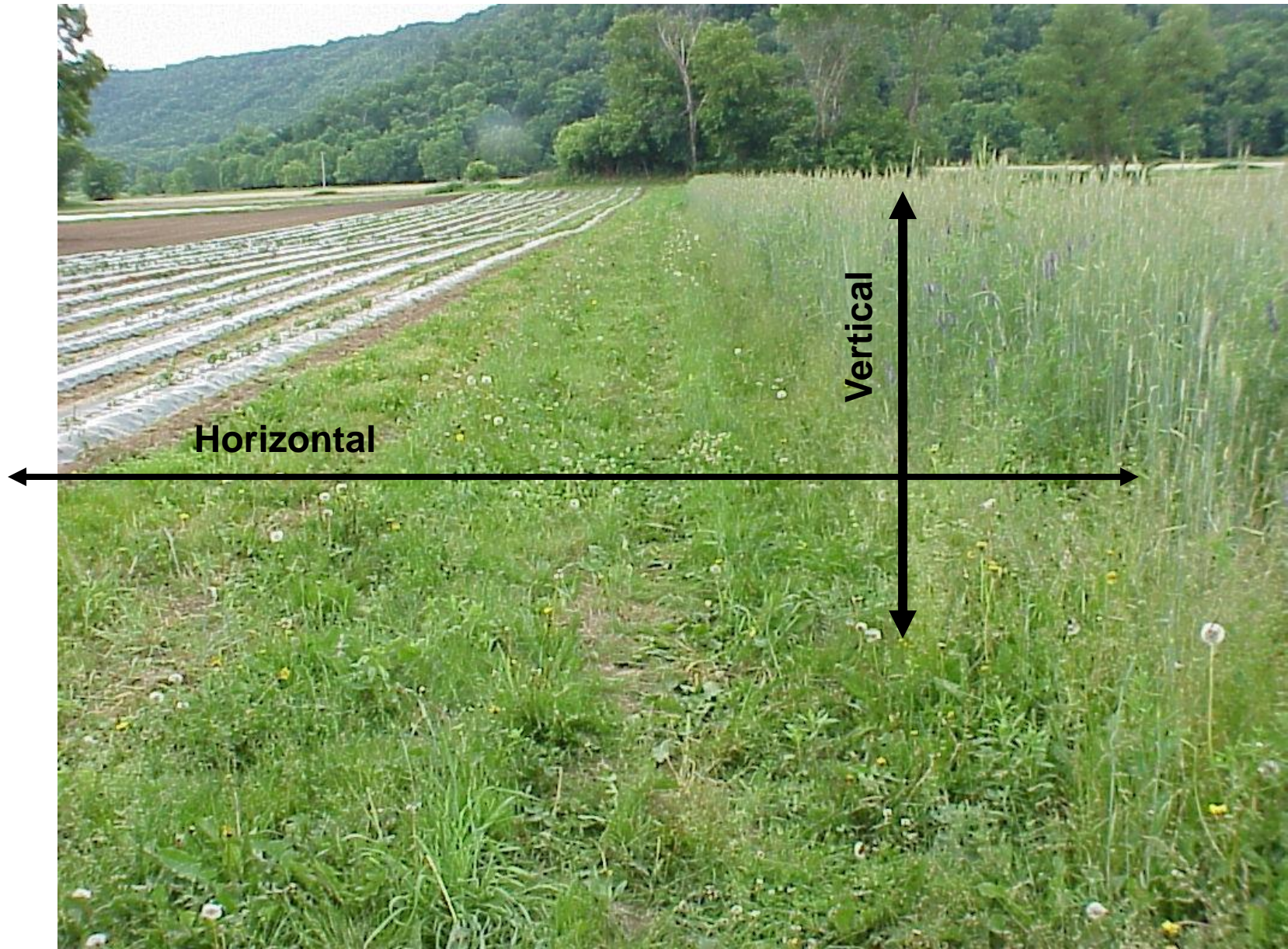
# Ensuring Organic Integrity

- Adjoining land use
  - Isolation
  - Buffers
  - Drainage diversion
  - Signage
  - Notification & accommodation





# Ideal Field Buffer



# Ensuring Organic Integrity

- Construction materials
  - Treated lumber is prohibited as per §205.206(f)
- Commingling issues

# Record Keeping [§205.103]

## Organic Farm Records Must:

- be well-adapted to the business being conducted,
- disclose all activities and transactions in adequate detail,
- be maintained for not less than five years beyond their creation,
- be sufficient to demonstrate compliance with federal regulations, and
- be available for inspection and copying during normal business hours.

# Documents To Keep

- Field histories
- Field activities
- Materials applications
- Seed documents
- Input labels and documents
- Soil & water test reports
- Harvest and sales records

# Organic Certification

- Certification is required of all operations that sell, label, or represent their products as organic.
- Operations selling less than \$5000 of organic products annually are exempt from certification.
- Both exempt and non-exempt organic operations must comply with the organic standard.

# Steps To Certification

- I. Find a suitable certifier ([www.ams.usda.gov/nop/CertifyingAgents/Accredited.html](http://www.ams.usda.gov/nop/CertifyingAgents/Accredited.html))
- II. Complete application and Organic System Plan
- III. Completeness review
- IV. On-farm inspection
- V. Final review

*A reminder...*

# Organic Certification is *Process* Certification

In other words, it is a guarantee to the consumer that the product was produced and handled in a certain way. It does NOT guarantee that the product is “pesticide residue free.” Traces of synthetic pesticides are everywhere in the environment and no one can make that claim. Research has shown, however, that organic produce typically has much less residue since these chemicals are not directly used in their production. Consumers can certainly expect that much!

# For the Non-Certified Producer

- Cannot use USDA Seal
- Cannot sell for organic processing
- Organic System Plan required
- Sorting through the materials mess



# **What is organic farming?**

Organic farming works in harmony with nature rather than against it. This involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it. The methods and materials that organic farmers use are summarised as follows:

**To keep and build good soil structure and fertility:**

**To control pests, diseases and weeds:**

## **To keep and build good soil structure and fertility:**

- recycled and composted crop wastes and animal manures
- the right soil cultivation at the right time
- crop rotation
- green manures and legumes
- mulching on the soil surface

## **To control pests, diseases and weeds:**

- careful planning and crop choice
- the use of resistant crops
- good cultivation practice
- crop rotation
- encouraging useful predators that eat pests
- increasing genetic diversity
- using natural pesticides

## **Organic farming also involves:**

- careful use of water resources
- good animal husbandry

# **A modern approach to farming**

Organic farming does not mean going 'back' to traditional methods. Many of the farming methods used in the past are still useful today. Organic farming takes the best of these and combines them with modern scientific knowledge.

Organic farmers do not leave their farms to be taken over by nature; they use all the knowledge, techniques and materials available to work with nature. In this way the farmer creates a healthy balance between nature and farming, where crops and animals can grow and thrive.

To be a successful organic farmer, the farmer must not see every insect as a pest, every plant out of place as a weed and the solution to every problem in an artificial chemical spray. The aim is not to eradicate all pests and weeds, but to keep them down to an acceptable level and make the most of the benefits that they may provide.

## **Combined techniques**

On an organic farm, each technique would not normally be used on its own. The farmer would use a range of organic methods at the same time to allow them to work together for the maximum benefit. For example the use of green manures and careful cultivation, together provide better control of weeds than if the techniques were used on their own.

# Why farm organically?

Organic farming provides long-term benefits to people and the environment.

Organic farming aims to:

- increase long-term soil fertility.
- control pests and diseases without harming the environment.
- ensure that water stays clean and safe.
- use resources which the farmer already has, so the farmer needs less money to buy farm inputs.
- produce nutritious food, feed for animals and high quality crops to sell at a good price.

Modern, intensive agriculture causes many problems, including the following:

- Artificial fertilisers and herbicides are easily washed from the soil and pollute rivers, lakes and water courses.
- The prolonged use of artificial fertilisers results in soils with a low organic matter content which is easily eroded by wind and rain.
- Dependency on fertilisers. Greater amounts are needed every year to produce the same yields of crops.
- Artificial pesticides can stay in the soil for a long time and enter the food chain where they build up in the bodies of animals and humans, causing health problems.
- Artificial chemicals destroy soil micro-organisms resulting in poor soil structure and aeration and decreasing nutrient availability.
- Pests and diseases become more difficult to control as they become resistant to artificial pesticides. The numbers of natural enemies decrease because of pesticide use and habitat loss.



# Rotations

Growing the same crops in the same site year after year reduces soil fertility and can encourage a build up of pests, diseases and weeds in the soil. Crops should be moved to a different area of land each year, and not returned to the original site for several years. For vegetables a 3 to 4 year rotation is usually recommended as a minimum.

Crop rotation means having times where the fertility of the soil is being built up and times where crops are grown which remove nutrients.

Crop rotation also helps a variety of natural predators to survive on the farm by providing diverse habitats and sources of food for them.

A typical 4 year rotation would include a cycle with maize and beans, a root crop and cereals with either of the following;

1. Grass or bush fallow (a fallow period where no crops are grown).
2. A legume crop where a green manure, which is a plant grown mainly for the benefit of the soil, is grown (more information about green manures can be obtained from HDRA).

# Composting

Compost is organic matter (plant and animal residues) which has been rotted down by the action of bacteria and other organisms, over a period of time. Materials such as leaves, fruit skins and animal manures can be used to make compost. Compost is cheap, easy to make and is a very effective material that can be added to the soil, to improve soil and crop quality.

- Compost improves the structure of the soil. This allows more air into the soil, improves drainage and reduces erosion.
- Compost improves soil fertility by adding nutrients and by making it easier for plants to take up the nutrients already in the soil. This produces better yields.
- Compost improves the soil's ability to hold water. This stops the soil from drying out in times of drought.
- Compost can reduce pests and diseases in the soil and on the crop.

Compost has many advantages over chemical fertilisers. These provide nutrients for plants but do not improve soil structure. They usually only improve yields in the season in which they are applied. Because compost feeds soil life and improves soil structure, the beneficial effects are long lasting.

# Mulching

Mulching means covering the ground with a layer of loose material such as compost, manure, straw, dry grass, leaves or crop residues. Green vegetation is not normally used as it can take a long time to decompose and can attract pests and fungal diseases.

Mulches have several effects on the soil which help to improve plant growth:

- Decreasing water loss due to evaporation
- Reducing weed growth by reducing the amount of light reaching the soil
- Preventing soil erosion
- Increasing the number of micro-organisms in the top soil
- Adding nutrients to the soil and improving soil structure
- Adding organic matter to the soil

Alternative mulching materials include black plastic sheeting or cardboard. However these materials do not add nutrients to the soil or improve its structure.

## **How to use mulches**

- Always apply mulches to a warm, wet soil. Mulch applied to a dry soil will keep the soil dry.
- Care should be taken as to the thickness of the mulch applied. Too much mulch will prevent air flow and encourage pests.
- To allow the germination of planted seeds through the mulch, a layer of less than 10cm should be used.
- To clear an area of land of persistent weeds a layer of 10cm or more can be used.

## **Green manures**

Green manures, often known as cover crops, are plants which are grown to improve the structure, organic matter content and nutrient content of the soil. They are a cheap alternative to artificial fertilisers and can be used to complement animal manures.

Growing a green manure is not the same as simply growing a legume crop, such as beans, in a rotation. Green manures are usually dug into the soil when the plants are still young, before they produce any crop and often before they flower. They are grown for their green leafy material which is high in nutrients and provides soil cover. They can be grown together with crops or alone.

## Green manures:

- Increase and recycle plant nutrients and organic matter
- Improve soil fertility
- Improve soil structure
- Improve the ability of the soil to hold water
- Control soil erosion
- Prevent weed growth
- Stop nutrients being washed out of the soil, for example, when the ground is not used between main crops.



*Centro* (*Centrosema pubescens*),  
a useful green manure

## **Weed control**

In organic farming systems, the aim is not necessarily the elimination of weeds but their control. Weed control means reducing the effects of weeds on crop growth and yield.

Organic farming avoids the use of herbicides which, like pesticides, leave harmful residues in the environment. Beneficial plant life such as host plants for useful insects may also be destroyed by herbicides.



On an organic farm, weeds are controlled using a number of methods:

- Crop rotation
- Hoeing
- Mulches, which cover the soil and stop weed seeds from germinating
- Hand-weeding or the use of mechanical weeder
- Planting crops close together within each bed, to prevent space for weeds to emerge
- Green manures or cover crops to outcompete weeds
- Soil cultivation carried out at repeated intervals and at the appropriate time, when the soil is moist. Care should be taken that cultivation does not cause soil erosion.
- Animals as weeder to graze on weeds

Weeds do have some useful purposes. They can provide protection from erosion, food for animals and beneficial insects and food for human use.

## **Natural pest and disease control**

Pests and diseases are part of nature. In the ideal system there is a natural balance between predators and pests. If the system is imbalanced then one population can become dominant because it is not being preyed upon by another. The aim of natural control is to restore a natural balance between pest and predator and to keep pests and diseases down to an acceptable level. The aim is not to eradicate them altogether.

## Natural control

There are many ways in which the organic farmer can control pests and diseases.

- Growing healthy crops that suffer less damage from pests and diseases.
- Choosing crops with a natural resistance to specific pests and diseases.  
Local varieties are better at resisting local pest and diseases than introduced varieties.
- Timely planting of crops to avoid the period when a pest does most damage.
- Companion planting with other crops that pests will avoid, such as onion or garlic.

- Trapping or picking pests from the crop.
- Identifying pest and diseases correctly. This will prevent the farmer from wasting time or accidentally eliminating beneficial insects. It is therefore useful to know life cycles, breeding habits, preferred host plants and predators of pests.
- Using crop rotations to help break pest cycles and prevent a carry over of pests to the next season.
- Providing natural habitats to encourage natural predators that control pests. To do this, the farmer should learn to recognise insects and other animals that eat and control pests.



