

# Crop Rotation and Weed Control

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## Acknowledgements

- Canadian Organic Growers
- Ecological Farmers
- Boettcher Family Farm

<http://www.ag.ohio-state.edu/~news/story.php?id=2271>

## **Crop Rotation Key Player Affecting Weed Seedbanks**

Ohio Agricultural Research and Development Center (OARDC) has found that rotation, not tillage system, is the most important agent affecting the size, composition and impact of weed seedbanks in major field crops.

"The secret to weed-fighting .....is to choose management techniques that will keep the most troublesome species away. ....in continuous corn, the problem might be solved by rotating to soybean or to oats and hay crops.

"When you reduce tillage, you are choosing weeds that are better adapted to little soil disturbance, .....But if you increase it, weeds accustomed to higher disturbance will take their place."

"The best thing to do is to switch rotation and tillage systems from time to time," ..... "If you stick to one single system for a long time, the weeds will become stronger and more difficult to manage."

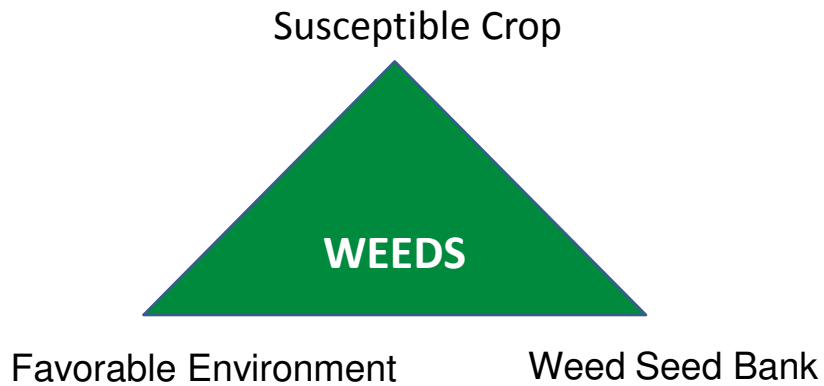
## **Soil Texture on your Farm?**

**Sand**  
**Sandy Loam**  
**Loam**  
**Clay Loam**  
**Clay**

**Main Crops?**

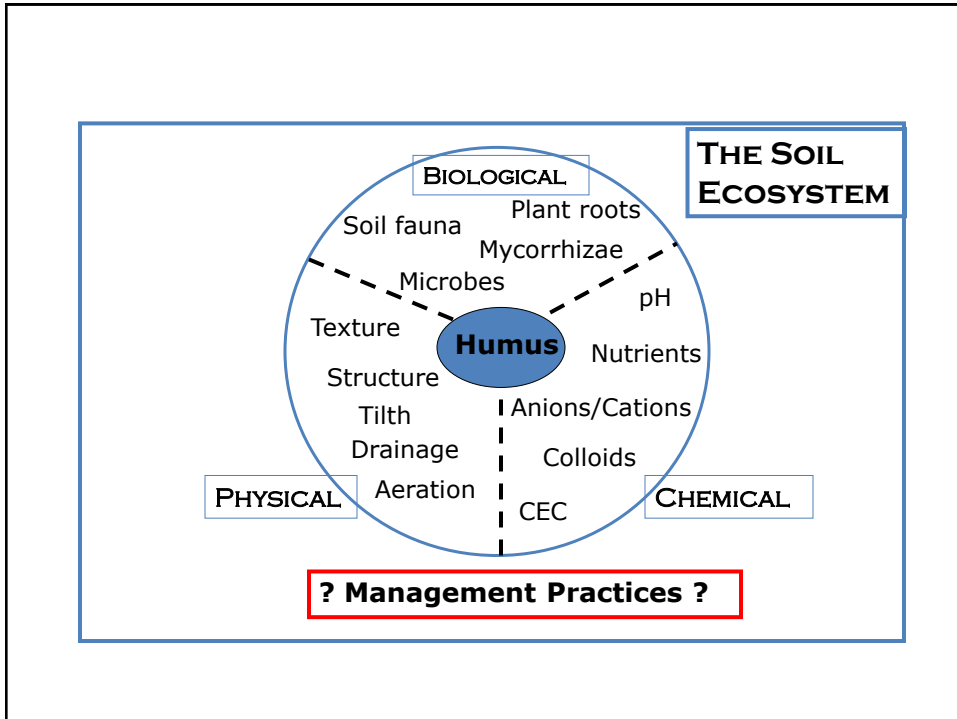
**Weed Issues?**

## Weed Triangle (Schonbeck ,Virginia)



### Approaches to Soil Management

- ⇒ **Physical** - Steel, Rubber, Diesel
  - high cash outlay
  - predictable results
  
- ⇒ **Chemical** - Fertilizer, Pesticides
  - high cash outlay
  - 3 calories in for 1 calorie out
  
- ⇒ **Biological** – on-farm resources
  - seed
  - low cash outlay
  - symbiosis of living systems
  - long-term predictability
  - limited only by the farmers imagination



## Principles of Crop Rotation

**Recreate the natural balances of diverse ecosystems for:**

- Nutrient cycling
- Breaking pest and weed cycles
- Building a living soil with organic matter

*“Create diversity through the crop rotation to achieve ecological balance”*

## Crop Selection

1. Value as cash crop or livestock feed
2. Soil-building properties
3. Nutrient Conservation
4. Weed and pest control
5. Demands on labour, equipment, knowledge and experience

## Crop Selection

### **2. Soil-building properties**

- Use green manures (at least 1 out of every 3 years)
- Alternate nitrogen-fixers (legumes) with high nitrogen consumers (corn, winter wheat)
- Alternate crops with different rooting characteristics
- Alternate low-residue crops with high residue crops
- Alternate allelopathic crops with non-allelopathic
- Intercrop: plant crops with different characteristics together

## Crop Selection

### 3. Nutrient Conservation

- Use legumes to fix atmospheric nitrogen
- Crops that increase phosphorous availability: buckwheat, mustard, oil radish, and lupines
- Include pasture in the rotation
- Don't sell off straw: plow it down or compost
- Store manure to prevent runoff: compost it

## Crop Selection

### 4. Weed and pest control

- Plant slow growing crops after weed suppressor crops
- Alternate between warm and cool season crops
- Plant perennial competition crops: forage legumes, mixed hay stands, fall rye, buckwheat
- Include row crops which permit mechanical weed control
- Select crops with a lifecycle that is different from persistent weeds
- Match crop nutrient demands with soil fertility
- Timing
- Maintain diversity

## **Crop Selection**

### **5. Demands on labour, equipment, knowledge and experience**

- Diversity in crops and farming activities should distribute the workload more evenly over the entire cropping season
- If using a new crop in the rotation, learn about the crop needs, and appropriate production techniques

## **Organic Weed Management**

### **• (requires a shift in thinking)**

- Not every weed is a problem  
~ do not need to be exterminated at all cost
- Weeds can be useful ie. Biodiversity, distracting pests from the crop, drawing up minerals
- Weeds are the result of management practices

## **Preventative Weed Management**

- Practices
  - **Balanced and healthy soils**
  - **Crop Rotations**
  - Good sanitation techniques
  - Appropriate crop varieties and production techniques
  - Cover / smother crops: green manures
  - Allelopathic cover crops
  - Living mulch / underseeding
  - Intercrop
  - Mow adjacent areas
  - Use weeds to benefit the farming operation

## **Direct measures to remove weeds**

- Pre-seeding tillage
- Pre-emergence tillage
- Post-emergence tillage
- Post-harvest tillage

***\* keep in mind that tillage is  
disruptive to soil life***



## **Boettcher Family Farm 6 Year Rotation**

Year 1 -Legume-Grass Mix

Year 2 Legume-Grass Mix – seed spelt

Year 3 Spelt – underseed red clover

Year 4 Oats – oat cover

Year 5 Soybeans – rye cover

Year 6 Rye harvest – underseed Legume-Grass

## **Boettcher Family Farm – Brussels ON**

- 6-year cropping sequence including a grazing ruminant component.
- Soil biology further enhanced by biodynamic practices.
- Provide for essentials of soil life – air water food
- Minimize tillage disturbance of soil life
- Avoid bare soils
- Perennial forages in rotation to build up fragile soil life.
- Each field gets cropped and grazed yearly (intensify nutrient cycling).
- Provide livestock manure or winter compost.
- Pump in solar energy (sugars) to feed soil life with green manure plants (clovers, green oats, brassicas and volunteer weeds)

Year	Crop/Operation	Comments
Year 1	<ul style="list-style-type: none"> <li>• <u>Legume/grass mix</u></li> <li>• (3 legumes, 3 grasses)</li> <li>• One cutting for hay, one grazing with flock</li> </ul>	<ul style="list-style-type: none"> <li>• Building up fertility and humus</li> <li>• Diversity in root species</li> <li>• Forage tops converted by ruminants into fertilizer</li> <li>• No tillage</li> </ul>
Year 2	<ul style="list-style-type: none"> <li>• <u>Legume/grass mix</u></li> <li>• One cutting, one grazing</li> <li>• 5 tonnes/acre winter compost worked in</li> <li>• Disk and rip up forage stand</li> <li>• Spelt seeding</li> </ul>	<ul style="list-style-type: none"> <li>• Root mass to feed soil life</li> <li>• Maximum build-up of soil fertility</li> </ul>
Year 3	<ul style="list-style-type: none"> <li>• <u>Spelt for harvest</u></li> <li>• Red clover underseeding</li> <li>• Grazing in September/October</li> <li>• 1-2 offset diskings</li> </ul>	<ul style="list-style-type: none"> <li>• Spelt (mediocre root system) heavy user of fertility</li> <li>• Red clover builds fertility back up</li> </ul>
Year 4	<ul style="list-style-type: none"> <li>• <u>Oats for harvest</u></li> <li>• After harvest: oats broadcasted and disked in</li> <li>• Green oats (or seed cocktail) for grazing in November/December</li> </ul>	<ul style="list-style-type: none"> <li>• Oats – medium fertility user with superb root system</li> <li>• Superior soil tilth (calcium, phosphorus and micronutrient accumulator)</li> <li>• No fall tillage</li> </ul>
Year 5	<ul style="list-style-type: none"> <li>• Broadcast and harrowed in oats ahead of</li> <li>• <u>Soybeans for harvest</u></li> <li>• Broadcast and light disk rye after soy harvest</li> </ul>	<ul style="list-style-type: none"> <li>• Oats easy to undercut for soy seeding</li> <li>• Superb tilth</li> <li>• High brix soybeans =&gt; aphid management</li> </ul>
Year 6	<ul style="list-style-type: none"> <li>• <u>Rye for harvest</u></li> <li>• Legume/grass mix underseeding</li> <li>• Light grazing in October</li> </ul>	<ul style="list-style-type: none"> <li>• Rye uses up remnant fertility</li> <li>• Good weed suppression</li> <li>• Legume/grass mix provides diversity again</li> <li>• No tillage</li> </ul>

## Results at Boettcher Family Farm

- Soil feels spongy and smells woody (bacteria, fungi and earthworms)
- Soil is more friable: less diesel required for tillage and aerobic zone deepened.
- More resistant to weather extremes
- More balanced nutrition for “higher level” crop plants => discourages “lower level” weed species.
- Fungal and bacterial soil components in proper ratio, soil food web is humming and farmer is happy
- Healthy soil life makes locked up nutrients available to plants and prevents leaching of minerals. Microorganisms are very important in correcting soil mineral imbalances.

## Soil Conditions and Associated “Weeds

<b>Fertile cultivated soils</b>	- Lambs quarters - Chickweed	- Pigweed - Chickory
<b>Low Fertility</b>	- Wild Carrot - Mullein	- Wild Parsnip - Ox-eye daisy
<b>Potassium Levels</b>	- high levels – Red clover, Wormwood, (clay soils) - low levels - Yarrow (sandy /loam soils) - unavailable K - Ragweed (wet loam/clay soils)	
<b>Alkaline Soils</b>	- Bladder Campion - Mustards	- Wild Carrot - Sow Thistle
<b>Acid Soils</b>	- Sorrel - Horsetail	-Docks - Hawkweed
<b>Hard pan and/or Crust</b>	- Quack grass(fertile) - Chamomille	- Mustard - Bindweed (sandy)
<b>Clay/Heavy, wet</b>	- Buttercup - Sow thistle	- Coltsfoot - Canada Thistle
<b>Sandy Soils</b>	- White Cockle - Horsetail	- Goldenrod - Toadflax

## RESOURCES

**Weeds and What They Tell** – E. Pfeiffer

**The Soul of Soil** – Gershuny and Smillie

**Soil Biology Primer** – Soil and Water Conservation Society

**Building Soils for Better Crops & Managing Cover Crops Profitably**

- SAN (Sustainable Agriculture Network)

**Organic Field Crop Handbook and Gaining Ground**

- Canadian Organic Growers

**Planning the Perfect Rotation** – [www.newfarm.org](http://www.newfarm.org)

**An Ecological Understanding of Weeds** – [www.extension.org](http://www.extension.org)

- Virginia Association for Biological Farming