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Rotations for Organic Grain Cropping Systems

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under grant number 2013-51106-21005.

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Rotation

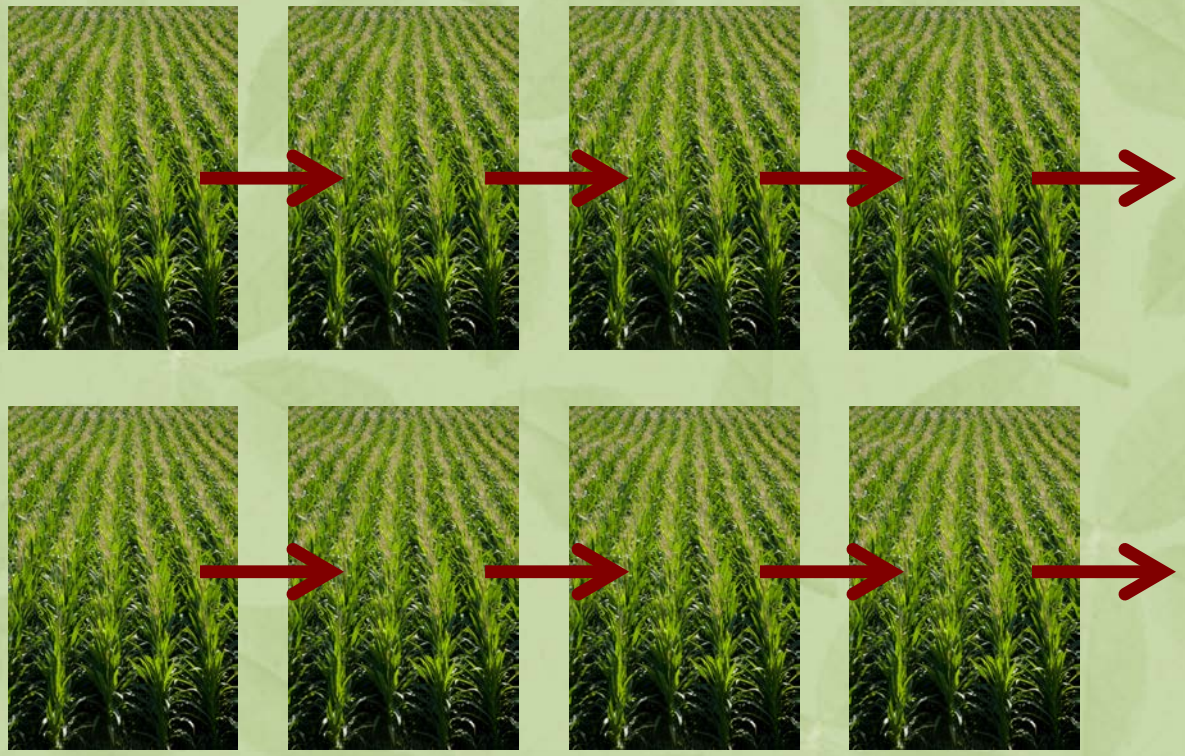
I. Definition
II. Benefits
III. NOP Standards
IV. Planning
V. Examples

Rotation Definition – NOP 205.205

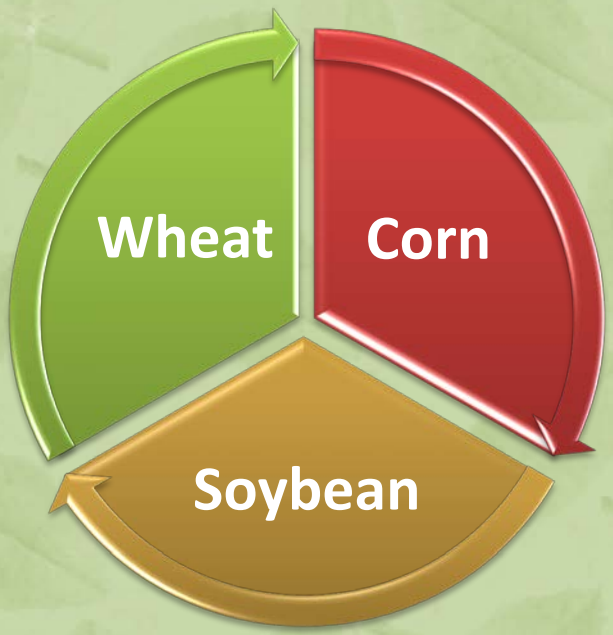
- A rotation is the “alternating of annual crops grown on a specific field in a planned pattern or sequence in successive crop years”
- Thus, “crops of the same species or family are not grown repeatedly without interruption on the same field”

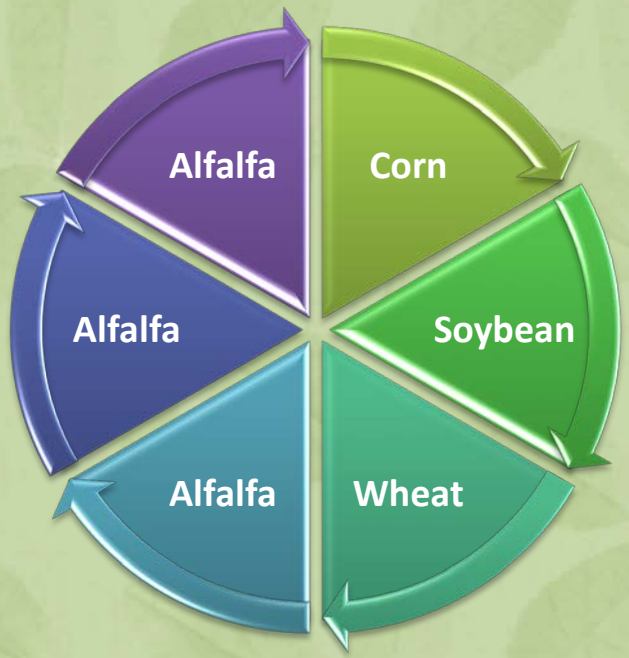
Continuous Cropping

- Example: growing corn in the same field every year
- Growing any annual crop two years in a row on the same field is **not** allowed in organic systems



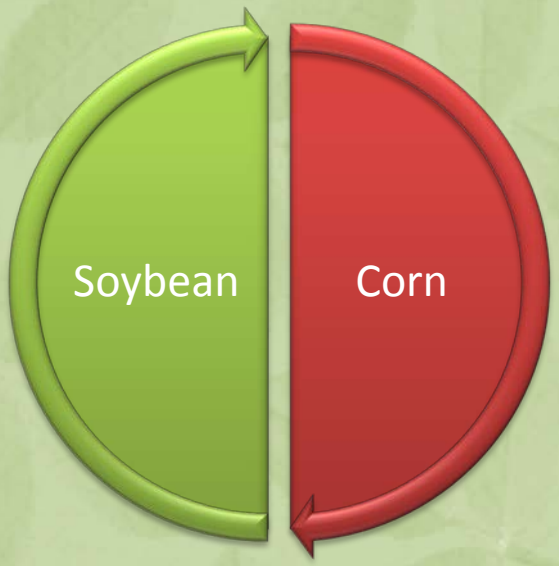
Rotation Types



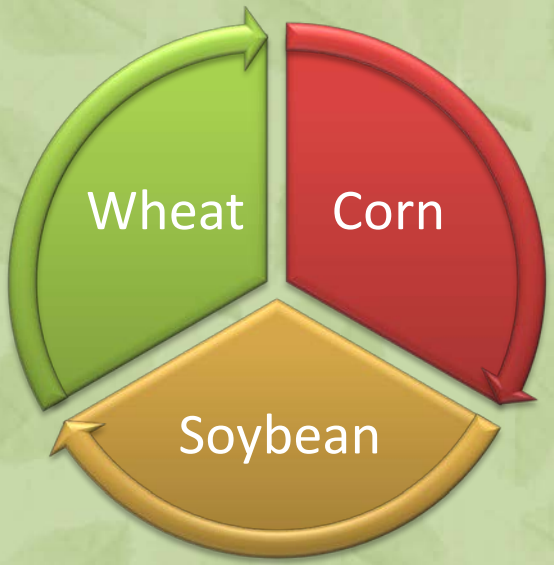


- Vary in length and diversity
- Vary by region based on crop adaptation

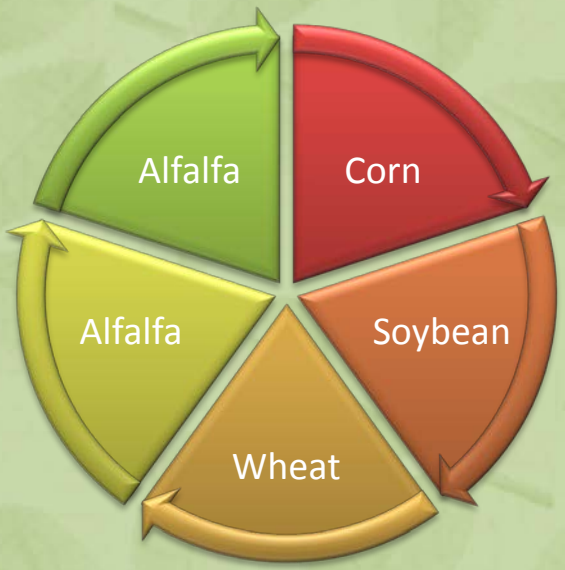
2 crops
2 years



3 crops
3 years



4 crops
5 years



ROTATION BENEFITS INCREASE

Rotation

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Benefits of Diverse Rotations

A. **Soil quality and fertility**
B. Weed management
C. Disease and insect management
D. Other benefits

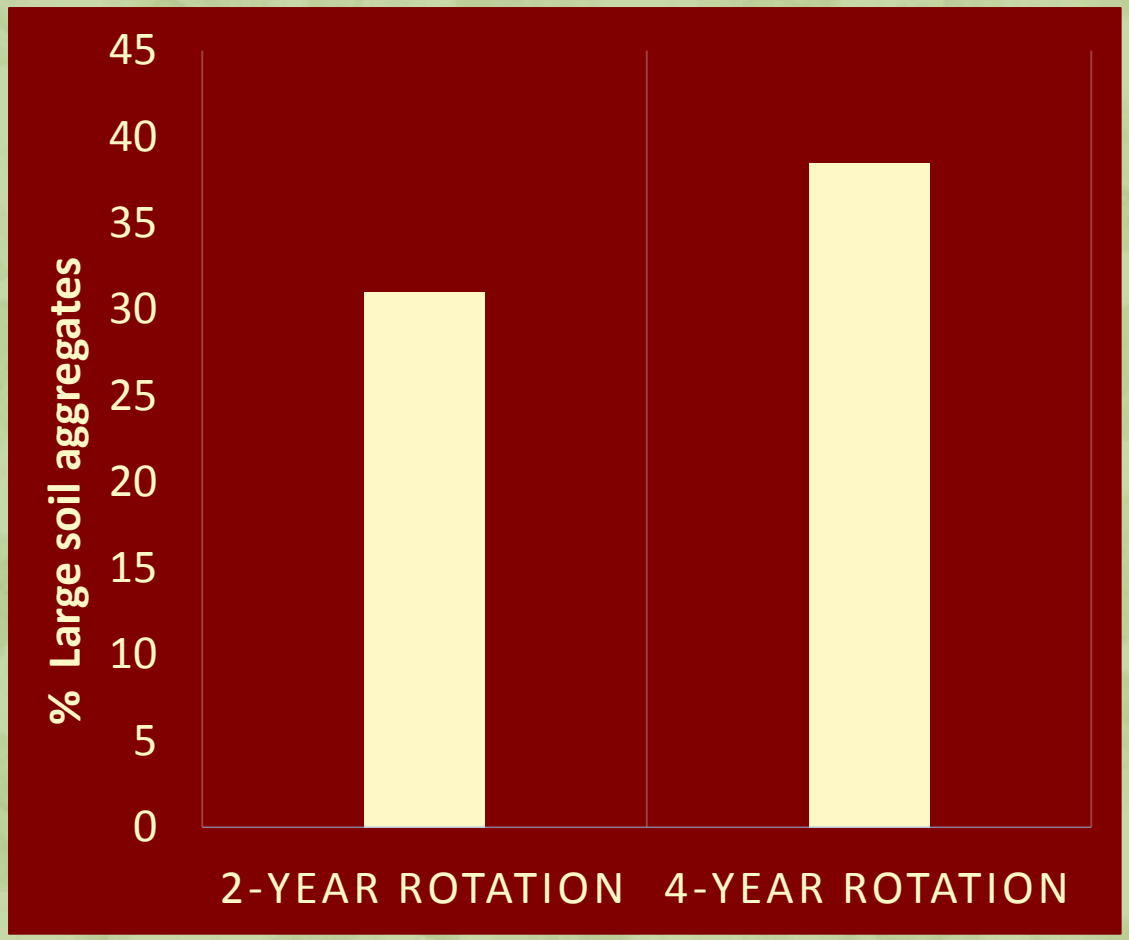
Soil Quality

Winter rye cover crop, spring growth

- Diverse rotations with perennials can increase soil organic matter
- Perennials and cover crops can overwinter for reduced soil erosion

Organic Rotation Experiment

- 2-year rotation = corn-soybean
- 4-year rotation = corn-soybean-oat-alfalfa
- **Greater number of large soil aggregates in 4-year rotation**



Kuratomi et al., 2004

Increased Soil Fertility

- Legumes (crops, cover crops, and green manures) add N to soils by nitrogen fixation
- Corn after alfalfa will often have all the nitrogen needed for good yields


Plot 1
Grown after alfalfa
Plot 2
Grown after wheat

Rotation Effect

Yields in rotations are greater than those in continuous cropping

Above that associated with increased N from legumes in rotation

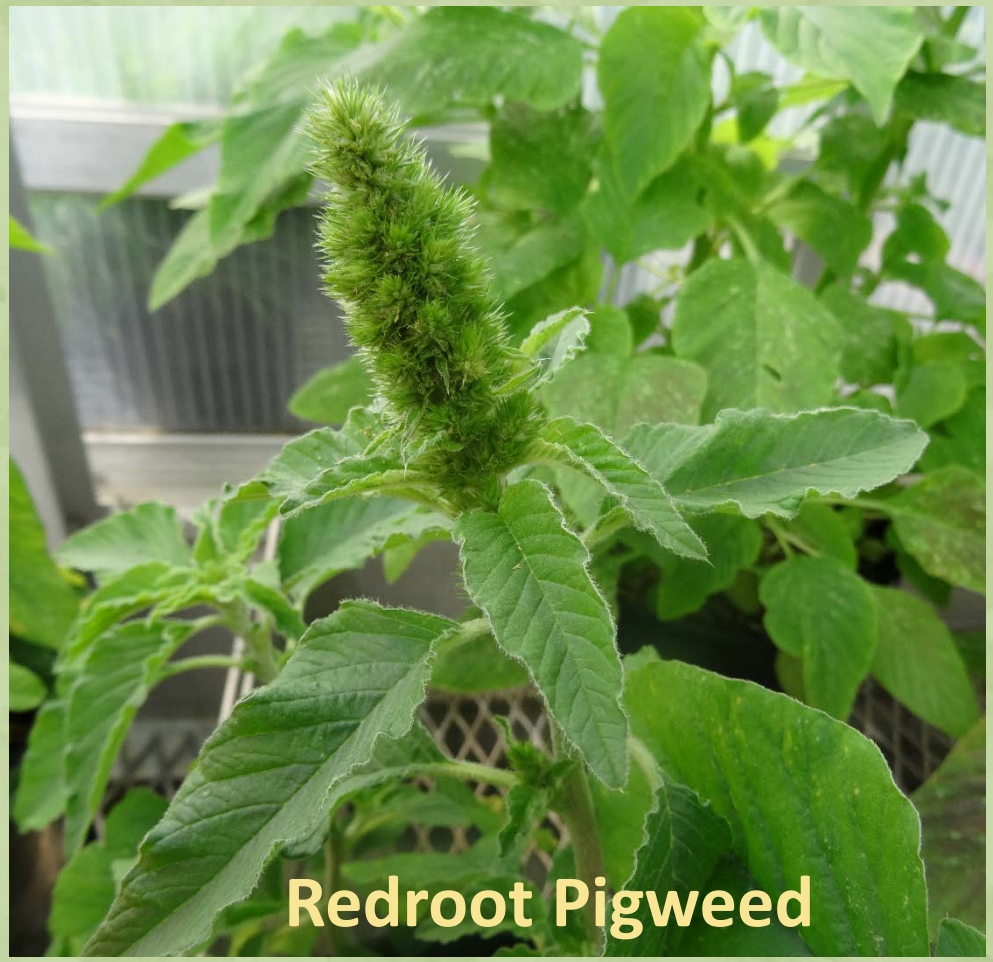
Exact reason why is unknown!

Benefits of Diverse Rotations

A. Soil quality and fertility
B. Weed management
C. Disease and insect management
D. Other benefits

Rotation Diversity and Weeds

- Repeatedly growing crops with similar production practices will lead to weeds adapted to those practices
- Examples in corn and soybean: pigweeds and foxtails



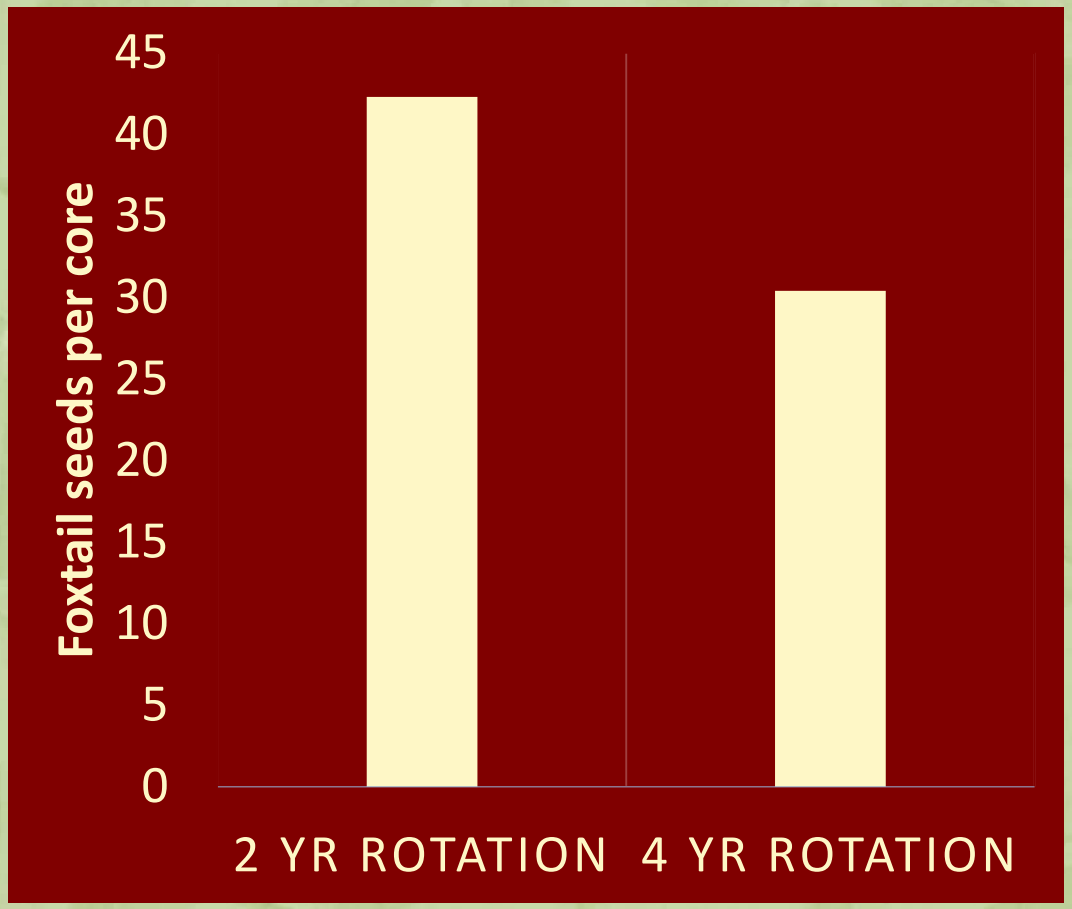
Small Grains in Rotation

- Cool season crops
- Have different times of planting and harvesting
- May help reduce weeds that thrive in row crop production

Perennial Forages

- Provide continuous soil cover to inhibit weeds from germinating
- Multiple harvest times can set back annual and perennial weeds

Rotation and Weed Seed Study



Foxtail seeds in the soil were lower in a 4-year rotation that included oats and alfalfa

Haar et al., 2008 (unpublished data)

Benefits of Diverse Rotations

A. Soil quality and fertility
B. Weed management
C. Disease and insect management
D. Other benefits

Disease and Insect Management

Rotation breaks up disease and insect cycles

Soybean Cyst Nematode Research

Rotation	SCN (eggs/100cc of soil)
Soybean once every 2 years	3657
Soybean once every 3 years	1306
Soybean once every 4 years	496
No soybean in rotation	0

Threshold for damage > 500 eggs/100cc

Chen et al., 2012

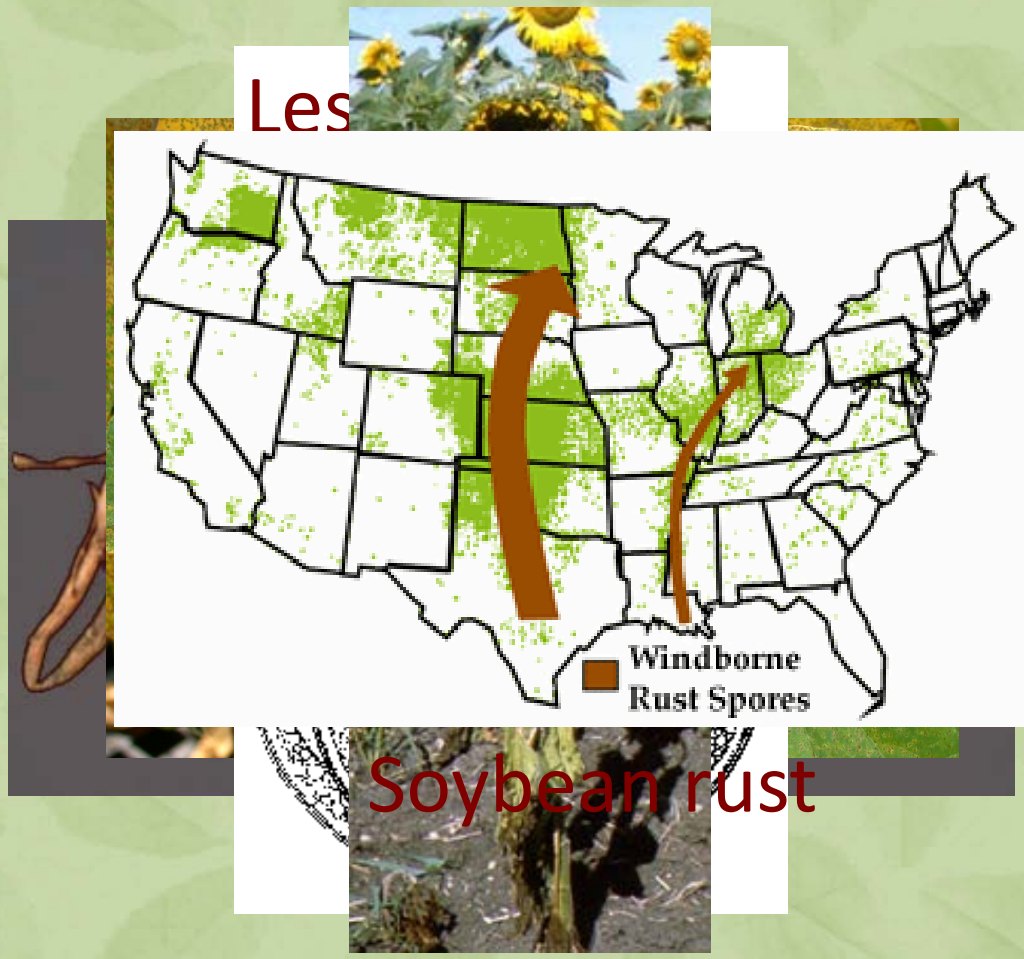
The more soybean is grown in a field, the more prevalent SCN becomes

Examples

Crop	Pest	Rotation Period
Corn	Corn root worm	1-2 years
Soybean	Soybean cyst nematode	3-5 years
Small grains	Scab	2-3 years

Some Pests Can't Be Managed with Rotation

- Some pests travel – Ex. soybean rust
- Some pests are ubiquitous – Ex. lesion nematode
- Some persist for many years – Ex. Sclerotinia
- Some disease survives without hosts – Ex. Pythium



Benefits of Diverse Rotations

A. Soil quality and fertility
B. Weed management
C. Disease and insect management
D. Other benefits

Reduced Financial Risk

- Diverse rotations can reduce financial risk from:
  - Crop failure
  - Price swings

Diversify Field Operations

- Spreads out work over the field season
- Reduces the risk of not having enough time to perform timely operations

Rotation

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II. Benefits
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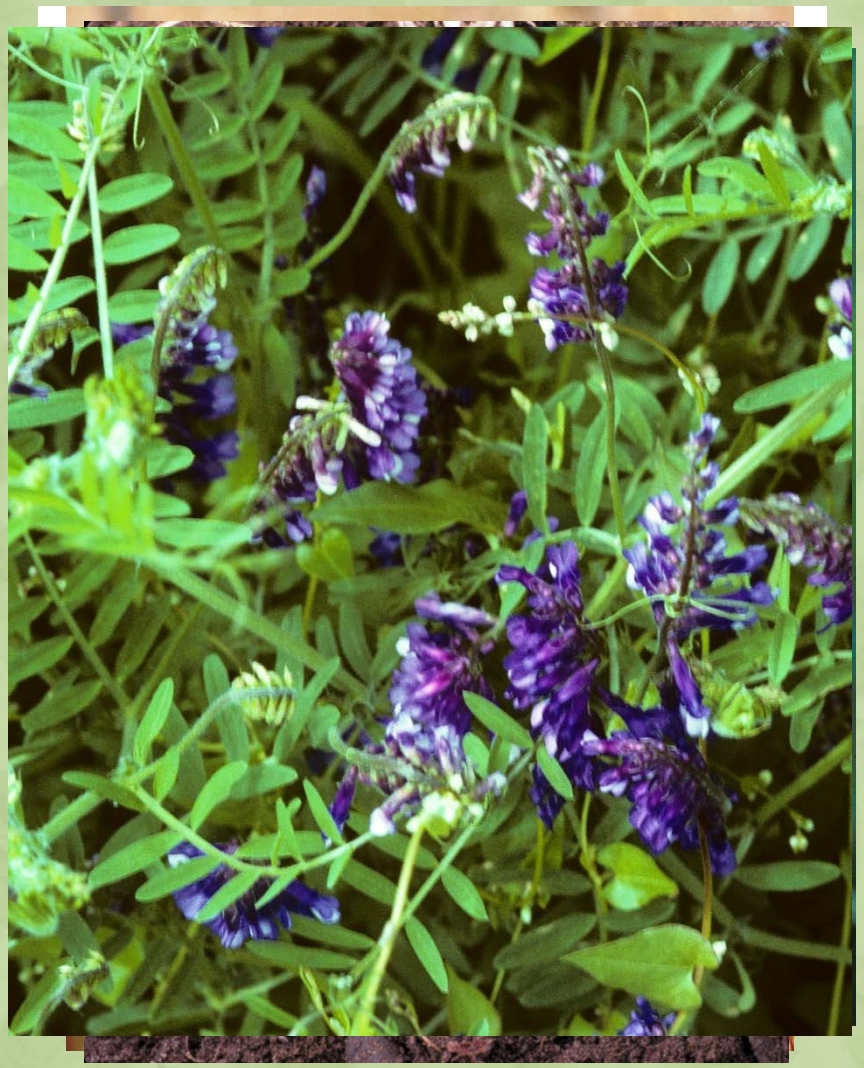
V. Examples
VI. Transition

Rotation Goals – NOP

The National Organic Program has a strong emphasis on diverse rotations because rotation is one of the strongest management tools an organic farmer has.

NOP Rotation Standards

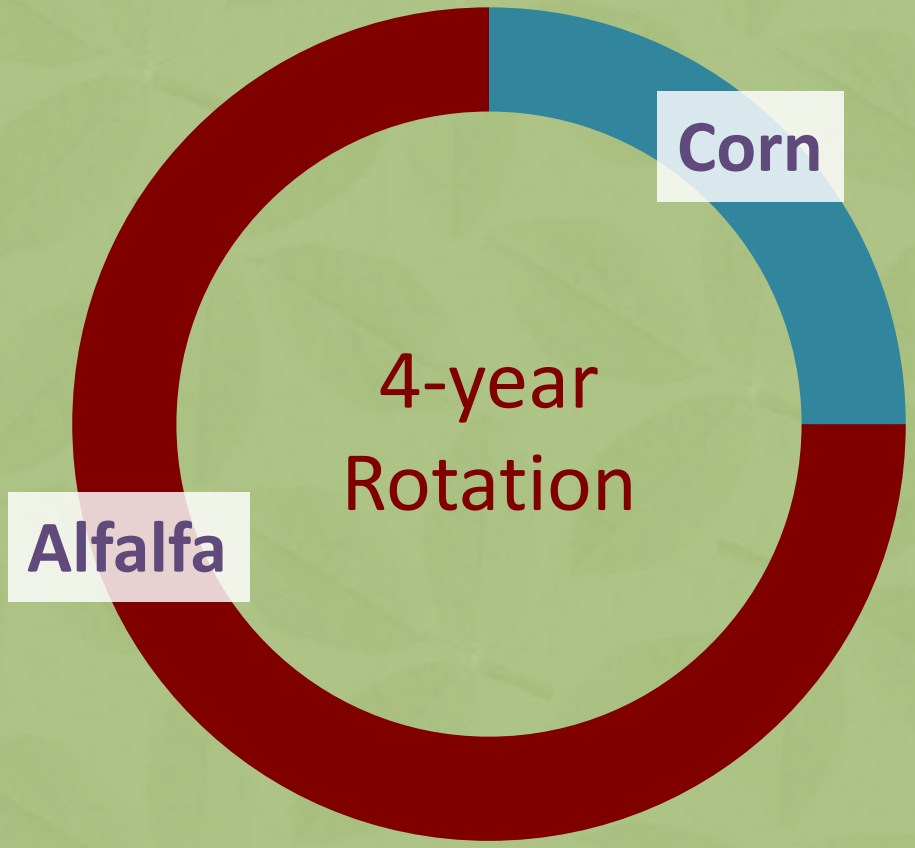
- Legumes
- Diversity of species and plant families
- Crops with different rooting systems
- Crops with different pest pressures
- Green manure and cover crops



NOP Rotation Standards

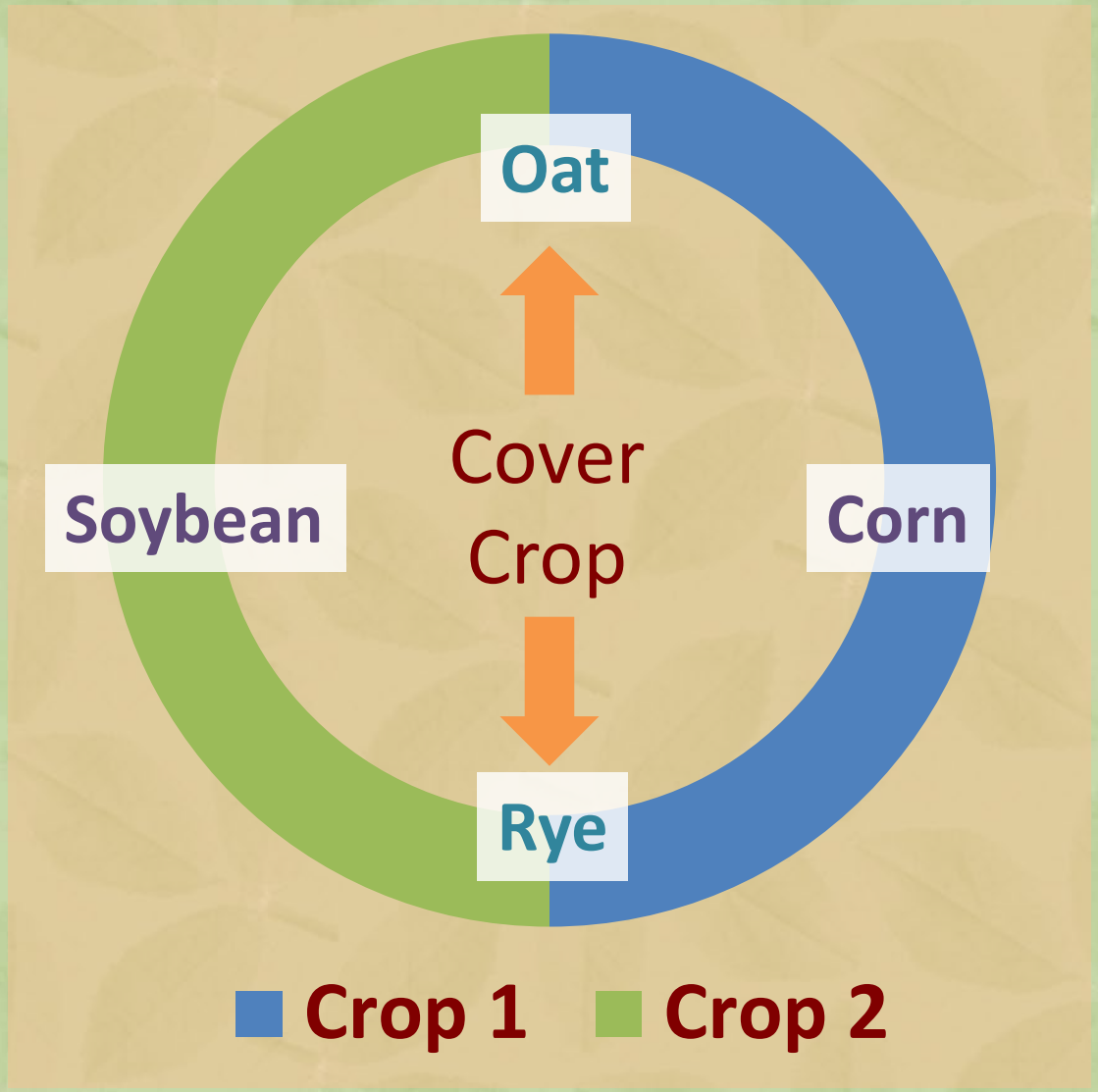
- Minimum of 3 crops within 5-year period for field crop systems
- Can't follow an annual crop with the same annual crop in the subsequent year

Exception 1



Two crops if one is a perennial grown for more than 2 years

Exception 2



Two crops, plus a cover crop

NOTE: ask Jim about whether certifiers can deny 2nd option

Rotation

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Important Considerations

A. Markets

B. Your Operation

C. Crop Sequence

D. Flexibility

Planning Your Rotation

Balancing profits with soil health and other rotation benefits is key to finding crop rotations that work best for your operation

Markets

Other Modules to View

Marketing

Growing a New Crop

Important Considerations

A. Markets

B. Your Operation

C. Crop Sequence

D. Flexibility

Your Operation – Crop Adaptation

- Consider:
  - Disease prevalence
  - Soil conditions

Wheat infected with fusarium head blight (scab)

Your Operation – Equipment

Do you have equipment or access to custom work?

Your Operation – Manure Availability

Important Considerations

A. Markets

B. Your Operation

C. Crop Sequence

D. Flexibility

Crop Sequence

Host crops for the same diseases should not be grown after one another

Crop Sequence

Crops that fix nitrogen should be followed by crops with high N needs

Crop Sequence

Less competitive should alternate with competitive crops

Important Considerations

A. Markets
B. Your Operation
C. Crop Sequence
D. Flexibility

Need for Flexibility

- Weather conditions
- Market changes
- Disease prevalence

If You Need to Make Changes

If You Need to Make Changes

1. All changes follow NOP rules
2. Notify your certifier of changes
3. Track changes in records including your Organic System Plan (OSP)

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Rotation Examples

3-Year Rotation – Example 1

Underseeded
w/ red clover

- Common rotation in regions without livestock
- Small grain often underseeded with red clover
- Compost or manure will likely be necessary
- Rotation is less diverse

3-Year Rotation – Example 2

- Similar to previous example
- Field peas are harvested early and allow time for planting a fall cover crop

4-Year Rotation – Example 1

- Good rotation for producers without manure
- Small grain underseeded with alfalfa
- Alfalfa will provide most of the N for the corn
- Alfalfa provides many benefits

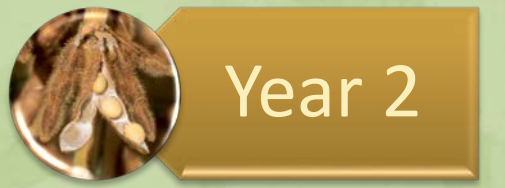
5-Year Rotation – Example 1

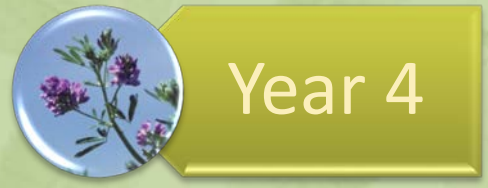
- Similar to previous example
- An additional year of alfalfa
- Should provide all of the N for the corn

5-Year Rotation – Example 2

- 2 years of high-value corn
- Year 3 corn will require fertilizer
- 3 years of row crops not ideal

Rotation Examples





These are examples that you can adjust to your own needs and experiences

Farmer Profile – Rotation

Small grain underseeded with legume

- **3-year rotation** = corn-soybean-small grain underseeded with red clover
- **6-year rotation** = corn-soybean-small grain-alfalfa-alfalfa-alfalfa

Rotations – Farm Scale

	Year 1				Year 2				Year 3				Year 4				Year 5			
	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI
Field 1: 5-yr rotation	Corn				Soybean				Oat				Alfalfa							
Field 2: 3-yr rotation	Wheat		Red Clover		Corn				Soybean				Oat		Red Clover		Corn			
Field 3: 3-yr rotation	Soybean				Barley		Red Clover		Corn				Soybean				Wheat		Red Clover	

- Different rotations for different fields
- Rotations are staggered

Resources

- Pioneering Illinois farmer recounts transition to organic – Rodale
- Tipsheet: Crop Rotation in Organic Farming Systems – ATTRA
- Crop Rotation on Organic Farms – SARE
- Risk Management for Organic Producers – Rotation

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