Planning for Flexibility in Effective Crop Rotations

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Outline

- Introductory comments
- What we learned from the famers
- Tools for crop rotation planning
- Basics of a planning procedure
- Managing pests and weeds with rotation

Crop rotation defined by NOP

- The practice of alternating the annual crops grown on a specific field in a planned pattern or sequence in successive crop years so that crops of the same species or family are not grown repeatedly without interruption on the same field.

Crop rotation

- Crop rotation is always a good idea
- For organic farmers, a good crop rotation is essential for success!
  - Critical for managing disease
  - Nutrients
  - Weeds
  - Building soil quality
  - [Insects]

Crop rotation can be incredibly complicated

- 8 to 30 crop species
- Huge variation in acreage among crops
- Some crops are in the ground more than one year
- Multiple plantings of some crops
- Some crops can only be grown on certain fields
- Cover crops between cash crops

NEON: Northeast Organic Network

- Rotation planner project was part of NEON
- Large, 3 year, regional collaborative project funded by USDA.
- Researchers, farmers, farmer organizations, non-profits.

Started by asking expert farmers how they plan crop rotations

- 12 peer nominated exemplary farmers
- Put them in a room for 3 days
- Formal information extraction process
  - DACUM = Develop A CUrriculuM
  - Originally devised for developing training manuals for industry
- The New England Small Farm Institute
  - Sue Ellen Johnson, Eric Toensmeier

The farmers


Identify rotation goals
Identify resources and constraints
Gather data
Analyze data
Plan crop rotation
WALK THE FIELDS
CREATE A MAP
TEST SOILS
Flexibility

Bottom line

- None of the 12 farmers develop long term rotation plans
  - Forward planning horizon is 12 to 18 months
- They have a crop mix – amounts of each crop that they want to grow
- They look at each field (bed) history, field characteristics, and place the most appropriate crop on that spot.
- They usually have a plan for the next cover crop and the next cash crop after that

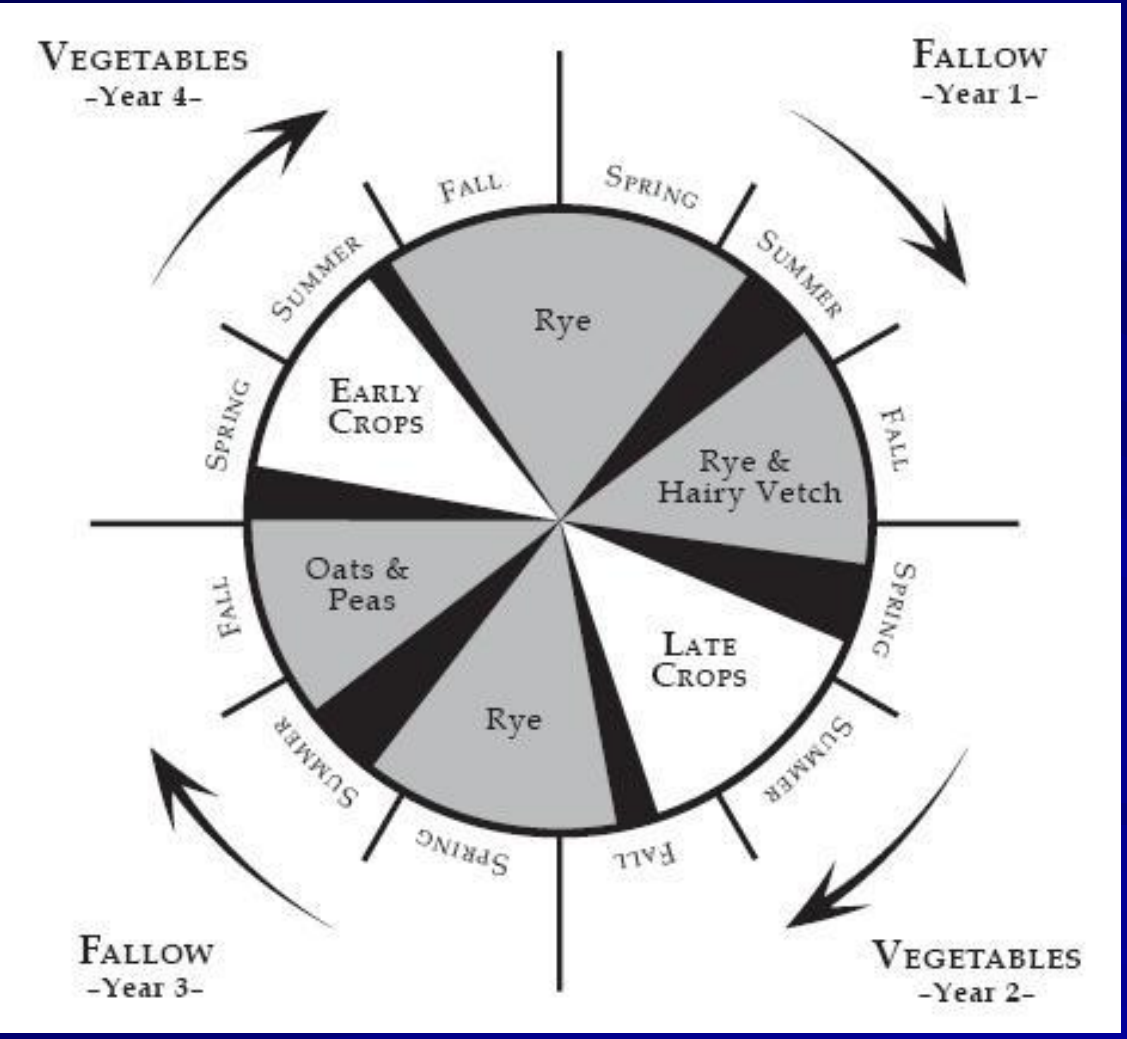
The reason:
Long-term plans always get derailed

- Weather conditions may delay planting or wipe out a crop and necessitate a substitute crop
- Market conditions change
- Labor supply may not be as expected

However . . .

- Some did their ad hoc placement within the context of a larger scheme
  - Drew Norman: a few years in vegetables, then a few years in hay

Some other farms studied by NEON used general rotation schemes as well



- Eric and Anne Nordell in N PA
- Have 12 half-acre strips. Sequence repeats 3 times
- *Ad hoc* placement of crops within strips.

Another example of a general plan

- Klaas and Mary Howell Martens in central NY – grain and processing vegetables
- 3-year plan
  - Bean (soybean, dry bean, snap bean)
  - Small grain (winter wheat, spelt, barley, oats), usually overseeded with red clover
  - Heavy feeder (corn, sweet corn, cabbage)
- Again, *ad hoc* choice of particular crop
- Occasional departure from the sequence

Crop Rotation on Organic Farms: a Planning Manual

- **CH 1.** Introduction (CLM)
- **CH 2.** How expert farmers manage crop rotations (SEJ)
- **CH 3**. Biological and physical processes in crop rotation (Various)
- **CH 4.** Example crop rotations (SEJ)
- **CH 5.** A crop rotation planning procedure (CLM)
- **CH 6**. Crop rotation during transition from conventional agriculture (CLM)
- **Ch 7**. Crop rotation and intercropping (CLM and Kim Stoner)
- Reference Tables

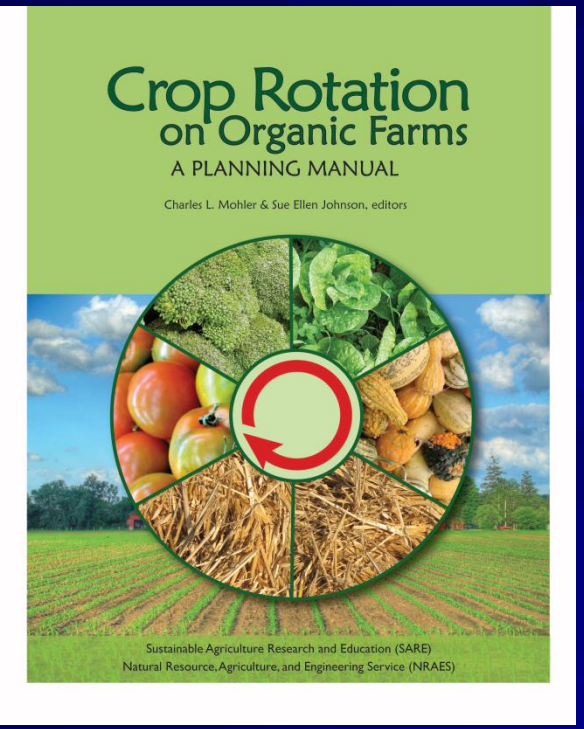
Appendix tables

- Crop characteristics
- Crop sequence problems and opportunities
- Sources of inoculum for crop diseases
- Weed characteristics relevant to crop rotation
- Crop diseases hosted by weeds
- Method for creating a field map in Excel

Following: Preceding:	Pea	Lettuce	Potato	Tomato
Pea	XXXX	D, C-		
Lettuce	D	XXXX	D	D, C-
Potato		D	XXXX	D, I
Tomato		D	D, I	XXXX

- D, I, W, C, N, S

Crop Rotation on Organic Farms: a Planning Manual



- Purchase book:

  PALS Publishing http://palspublishing.cals.cornell.edu/

- Free download:

  http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms

Planning procedure

- Purpose is not to tell the farmer what to do
- Purpose is
  - to help farmer organize information
  - to make decisions in an orderly series of steps
  - to facilitate checking for problems
- Goal: let anyone develop a plan that is as good as a really smart, experienced grower would produce.

Step 1 – Rotation goals

- Choose rotation goals
- Prioritize goals
  - Avoid soil-borne disease
  - Grow N-fixing cover crops
  - Suppress weeds

Step 2 – Do I want a general plan?

"Simple" operation

- Few crops
- Low variation in acreage among crops
- Rest years
- One cash crop/year
- Minor variation in soils, topography etc.

Focus on rotation planning

"Complex" operation

- Many crops
- High variation in acreage among crops
- Continuous cropping
- Multiple cropping
- Much variation in soils topography etc.

Focus on crop sequencing

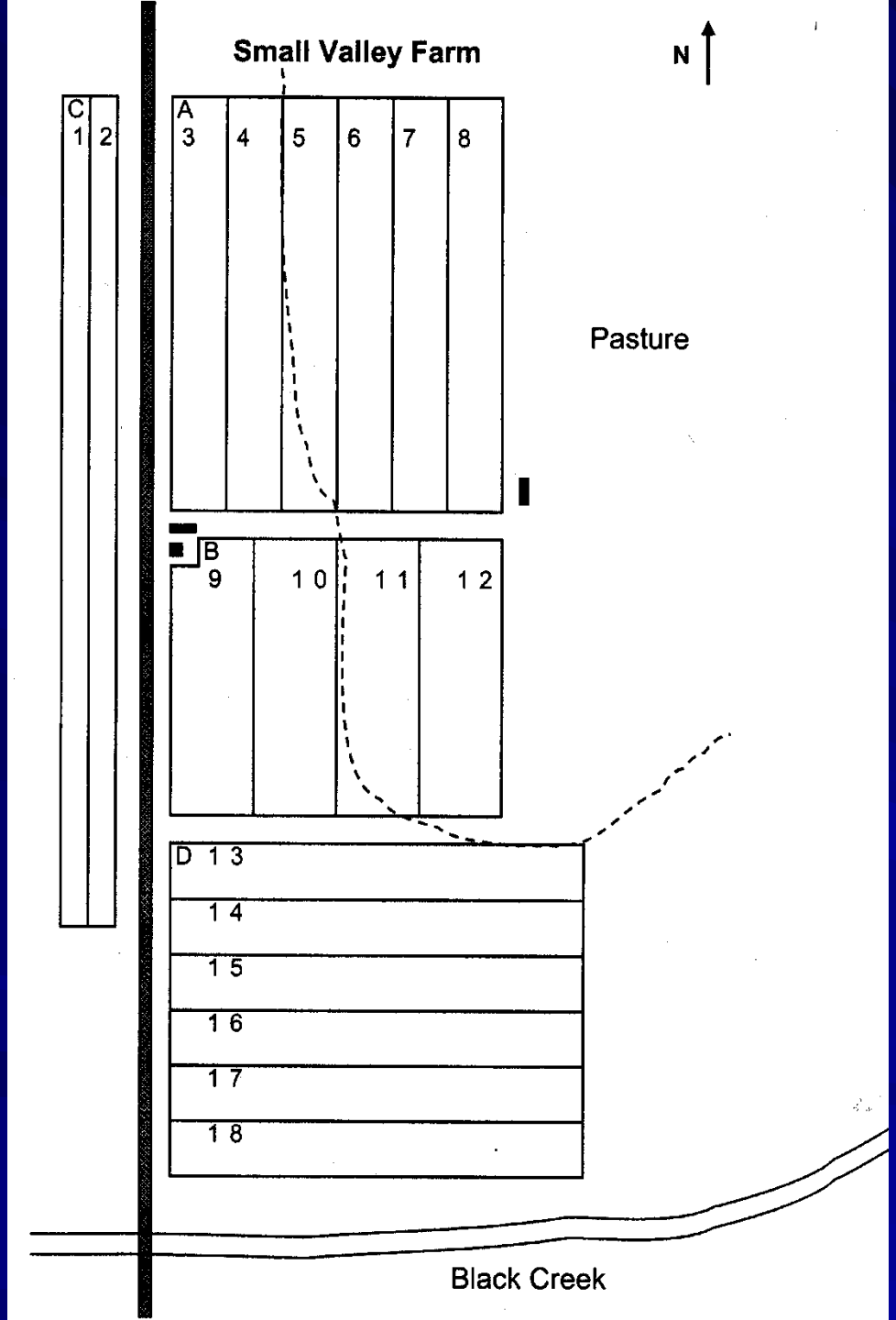
Write down the crop mix

Crop	Acres
Soybean (tofu)	120
Corn	120
Oat	120
Spelt	120
Hay	240

Check family return times

Onion	0.3	Lilly
Potato	0.5	Nightsh.
Tomato	0.3	Nightsh.
Lettuce	0.5	Aster
Pepper	0.2	Nightsh.
W. squash	0.4	Cucurb.
S. squash	0.2	Cucurb.
Brassicas	0.6	Brassica
Total	3.0	

- Nightshades have 1.0 A out of 3.0 A in production.
- 3.0/1.0 = 3
- On average, a bed will have a nightshade one year out of every 3 years
- Disease risk!
- Try for return times of at least 4 years for all families (except grasses)



Make a crop rotation planning map

- Equal area planning units
- Identify characteristics of each unit

Make a table

- For each management unit:
  - List critical characteristics
  - Crops for last 3 years

Example planning table

MU	Char	Three summers ago	Two winters ago	Two summers ago	Last winter	Last summer
9	early	Kohlrabi/ buckwheat	Oat	Pea/ Sorgh-sud	Oat	Carrot
10	early	Beet 5/ buckwheat	Oat	Pea/ Sorgh-sud	Oat	Carrot
11		Pepper	Oat	S. Squash	Oat	Pea/ Sorgh-sud
12		Pepper	Oat	S. Squash	Oat	Pea/ Sorgh-sud

Sort the management units

- 1, put MU's with similar *critical* field conditions together
- 2, put MU's with similar histories together

Plan future crop sequences – write crops onto the planning sheet

- Next summer
  - Cash crops already in the ground
  - Families that are close to the maximum allowable return time
  - High value crops that require special field conditions
  - Other valuable crops that grow anywhere
  - Less valuable crops that require special conditions
  - Less valuable crops that grow anywhere

Roxbury Farm

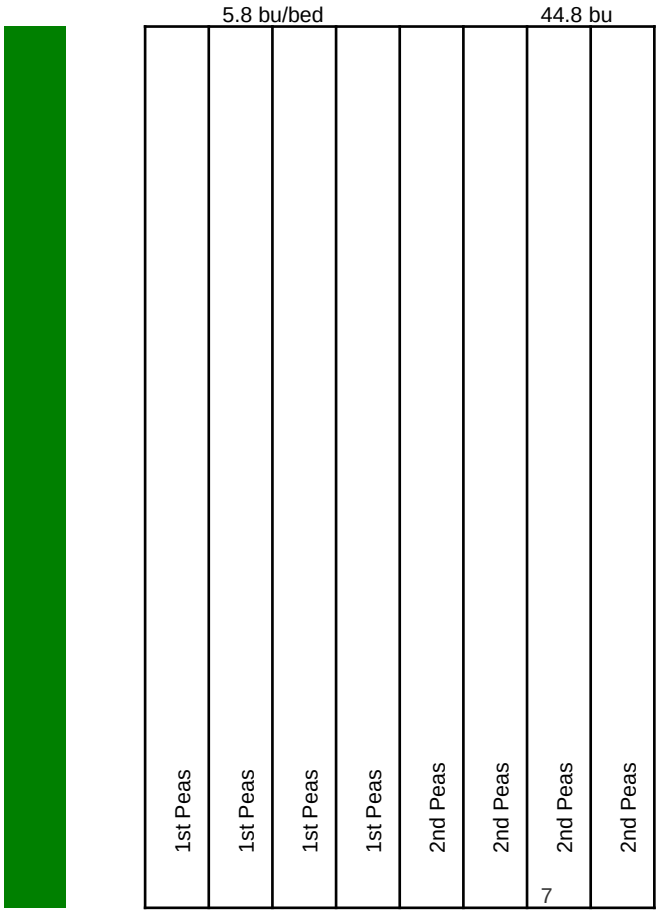
DATA

2006

Section 1

5.8 bu/bed

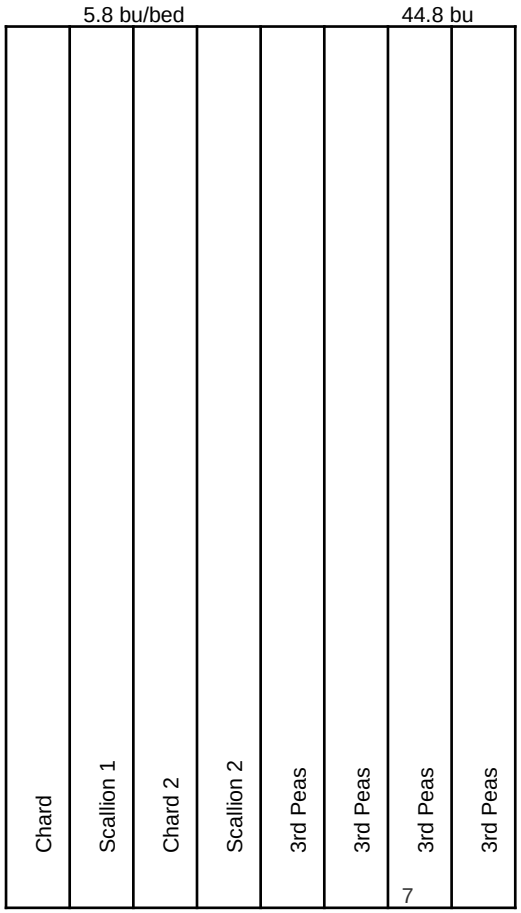
44.8 bu



Section 2

5.8 bu/bed

44.8 bu



ROUTE 9H

Sample mapping in Excel

Map

SECTION	BED	CURRENT PLANTING	DATE	SECOND PLANTING	DATE	COVER CROP	DATE
1	1	1st Peas	26-Mar	Lettuce 15	23-Jul	none	
6 bedunits	2	1st Peas	26-Mar	Lettuce 15	23-Jul	none	
Total 48	3	1st Peas	26-Mar	Dill, Cilantro 16	30-Jul	none	
	4	1st Peas	26-Mar	Lettuce 17	6-Aug	none	
	5	2nd Peas	2-Apr	Lettuce 17	6-Aug	none	
	6	2nd Peas	2-Apr	Lettuce 16	30-Jul	none	
	7	2nd Peas	2-Apr	Lettuce 16	30-Jul	none	
	8	2nd Peas	2-Apr	Spinach 16, 17	30-Jul	none	
SECTION	**BED**	**CURRENT PLANTING**	**DATE**	**SECOND PLANTING**	**DATE**	**COVER CROP**	**DATE**
2	1	Chard	9-Apr	Spinach 21	3-Sep	none	
6 bedunits	2	Scallion 1	9-Apr	Spinach 21	3-Sep	none	
Total 48	3	Chard 2	23-Apr	Lettuce 21	3-Sep	none	
	4	Scallion 2	23-Apr	Lettuce 21	3-Sep	none	
	5	3rd Peas	9-Apr	Lettuce 21	3-Sep	none	
	6	3rd Peas	9-Apr	Lettuce 20	27-Aug	none	
	7	3rd Peas	9-Apr	Lettuce 20	27-Aug	none	
	8	3rd Peas	9-Apr	Lettuce 20	27-Aug	none	

Future years

- Check next summer’s crop, mix
- Plan two summers from now
- Now go back and fill in cover crops between next summer and 2 summers from now

Put plans on maps and walk

- Put the plans on maps, one map per year
- Take the maps to the field – take notes
  - "Farm the land in your head"
- What could go wrong?
  - Note contingency plans !

An ecological perspective on rotation and pest management

- Annual crops
  - First year of ecological succession
  - Crop is at outbreak density & abundance
- Annual plants in nature escape by being unpredictable in space and time
- If we grow the same species repeatedly, in a field
  - then it isn't unpredictable
  - And it gets hammered
- Meanwhile weeds are moving in to drive succession forward

Rotation can’t solve all problems

Pest	agent	Rotation	Notes
Tomato bacterial spot	Xanthomonas campestirs pv. vesicatoria	Y (1-3)	seed borne
Club root	Plasmodiophora brassicae	Y (7)	weeds
Damping off	Pythium spp.	N	saprobe
Late blight	Phytophthora infestans	N	wind blown
Corn root worm	Diabrotica spp.	Y	life cycle
Imported cabbageworm	Pieris rapae	N	good flyer

Crop rotation for weed control

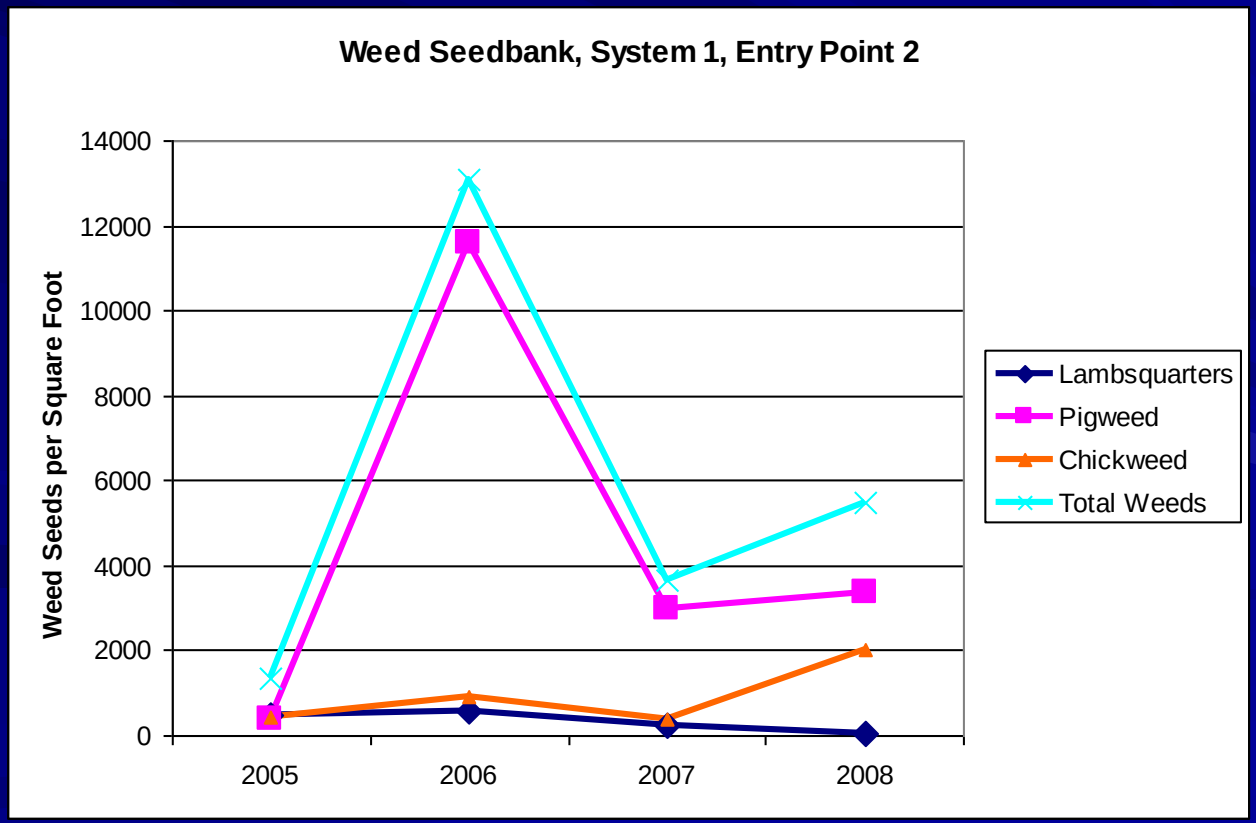
- Multi-year tactics.
- Often involves manipulation of the weed seed bank.
- Requires integration with tillage practices.

Tilled fallow

- Tillage promotes weed seed germination.
  - Firm seed bed
- Then shallowly till again to kill weeds
- Repeat.
- Plant

Follow weedy crops with crops that are easy to keep weeded

- This allows depletion of the seed bank built up in the previous year



Rotate between crops with different seasonality

Early summer planted

Spring planted

Mid-summer planted

Work cover crops into the rotation

- Sow heavy for best weed suppression.
- Winter cover can suppress quackgrass

Avoid cover crops that cause weed problems

- Example: hairy vetch can be a bad weed in wheat.

Rotate annuals with sod crops

- Repeated mowing depletes perennial weeds
- Annuals can’t reproduce so seed bank declines

Conclusions – lots of aspects to good rotation planning

- Several ways to use the book
- Reference
  - Basic principles and concepts of crop rotation
  - Look up information
- Inspiration – what do other farmers do
- Systematic planning too

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