Designing a Crop Rotation Plan with Farmers

University of Agriculture, Faisalabad, June, 2011
A system of farming in which a regular succession of different crops are planted on the same land area, as opposed to growing the same crop time after time (monoculture).
Benefits of crop rotation

- Reduces disease and insect problems
- Can improve soil fertility (legumes)
- Improves crop quality and yield by 10-15%
- Optimizes water use in rain-fed systems
- Reduces soil erosion
- Distributes labor over the year
- Diversifies crops produced
Barriers to adopt crop rotation

- Need increased management skills and information
- Need altered or new equipment to match changed farming practices
- Additional storage and processing needed for wider variety of crops produced
- Need to add livestock to utilize forages
- Herbicide carry-over
1. Identify and rank goals
2. Identify priority crops
3. Calculate the needed quantity of priority crops
4. Establish a sequence and length of rotation
5. Identify the strengths and weaknesses of the plan
6. Establish the field plan on paper
7. Test your plan
8. Implement your plan
9. Monitor implementation and redesign as needed
1- Identify and rank goals: Check off those goals that apply to you

- Increase farm profitability and improve cash flow
- Reduce fertilizer costs
- Disruption of weed, pest, or disease cycles
- Diversify farm products to spread market and weather risks
- Enhance livestock profitability or production
- Improve soil conservation
- Spread labor and equipment usage throughout the year
- Improve soil structure and fertility
- Enhance inter-seeding and cover cropping opportunities
- Better utilize available land

Kansas Rural Center Sustainable Agriculture management Guides, 1998. Crop Rotation.
Designing the plan

2- Identify priority crops:

- Rotation plans are usually built around one or two leading crops and one or more legumes

- Wheat
- Barley
- Chickpea
- Lentils
- Cotton
- Rice
Designing the plan

3- Calculate the needed quantity of priority crops:
- Determine the quantity of the priority crop as well as the area of land to cultivate

4- Establish a sequence and length of rotation:
- If forages are more important, or of equal importance with grain crops, rotations will be longer with more years of legumes and/or grasses
How long should the rotation last?

Depends on:

- Annual average rainfall
- Farming equipment available
- Markets
- Storage capacity
## Yield Increases with Crop Rotations

<table>
<thead>
<tr>
<th>Crop - Crop</th>
<th>Wheat Yield (kg/hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2083</td>
</tr>
<tr>
<td></td>
<td>2352</td>
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<td>3024</td>
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<td>2688</td>
</tr>
</tbody>
</table>

Examples - 2 year rotations

- **< 250 mm Precipitation**
  - Winter wheat
  - Fallow

- **> 350 mm Precipitation**
  - Winter wheat
  - Chickpea
5- Identify the strengths and weaknesses of the plan:
In terms of priorities and plan for compensating measures

- Supplement fertility with manure or fertilizers
- When comparing the economics give credits to: fertility improvement, weed control and other benefits
Examples - 3 Year Rotations

Fallow → Winter wheat → Spring barley

Chickpea → Winter wheat → Spring wheat

Canola → Winter wheat → Chickpea

Water requirement:
- 250 - 350 mm
- > 350 mm
Key role of legumes in crop rotation

- Nitrogen fixation
- Erosion control
- Soil structure improvement (especially if legumes is used as green manure)
- Break pest and disease cycles
- Increase moisture holding capacity and drought tolerance of soils

Any well-designed crop rotation should include legumes
Rotation Effects on Nitrogen Fertility

Wheat grain yield (kg per hectare) vs. Nitrogen rate (kg per hectare)

- Red dots: Chickpea-wheat
- Blue squares: Barley-wheat

Nitrogen fertility effect
Designing the plan

1- Identify and rank goals: Check off those goals that apply to you

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Examples - 4 Year Rotations

- Chickpea
- Winter wheat
- Lentil
- Spring wheat

Nitrogen / Yield
Crop Rotation for Weed Control

Certain crops are well known for their ability to suppress weeds:

- Sorghum
- Mustard
- Cereal Rye
- Barley
Examples - 4 Year Rotations

Chickpea → Winter wheat → Weed Control → Canola or Mustard → Lentil → Nitrogen / Yield → Spring wheat → Spring barley
Cover Crops and Green Manures

Green manure = crop incorporated into soil while green

- Add organic matter
- Fix nitrogen
- Suppress weeds & pests
- “Catch” crops
Green Manure Examples

Fall Planted
- Rye / Vetch

Spring Planted
- Oats / Peas

Summer Planted
- Buckwheat
Examples - 4 Year Rotations

- Chickpea
- Winter wheat
- Weed Control
- Nitrogen / Yield
- Lentil
- Canola
- Organic Matter
- Rye/Vetch + Buckwheat
- Spring wheat
- Spring barley
- Winter wheat
6- Establish the field plan on paper:

- Field maps and charts are very helpful in establishing the field plan and in deciding if, when and how to change field size and numbers.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field 1</td>
<td>Winter Wheat</td>
<td>Chickpea</td>
<td>Spring Barley</td>
</tr>
<tr>
<td>Field 2</td>
<td>Alfalfa</td>
<td>Winter Wheat</td>
<td>Chickpea</td>
</tr>
</tbody>
</table>
Designing the plan

7- Test your plan:

- Does this plan fit well with your rotation and farm goals?
- Are the cash crop and feed needs of the farm addressed?
- After figuring the market prices and production costs for the crops, is the projected profitability of the overall crop rotation plan satisfactory?
- Are the planned crops suitable to the land and the climate?
- Does the farm have adequate equipment for the overall plan?
- Is the seasonal distribution of labor workable?
- Are the pest and crop disease problems manageable?
- Is there adequate land available for the rotation plan?
Crop Rotations with Forages

- Increased Soil Nitrogen: Soil N levels increase by an average of 130lb/ac after 2 years of alfalfa, when two cuts were taken each year.
- Increased Soil Organic Matter: A 3-year perennial forage crop has been shown to return more than twice the soil organic matter as annual crops such as cereals or pulse crops.
- Livestock Feed

www.mbforagecouncil.mb.ca
Designing the plan

8- Implement the field plan:

A farmer can phase in a rotation system over a period of years. If the field plan fits the rotation well, one can start with the legume phase of the rotation bringing in a new field into the rotation each year.
Designing the plan

9- Monitor implementation and redesign the rotation as necessary:

Monitor the effectiveness of your rotation against the goals of your plan, changes in needs of your overall farm management and marketing strategy.

Establishing goals and priorities and having a well-designed plan are necessary to practice rotation-based farming with discipline and flexibility. One must keep in mind the key role of soil building legumes and include them in the rotation.

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Questions?