UT Extension
W235-E

Crop Rotations

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Crop rotation refers to the sequence of crops grown in a specific field, including cash crops, cover crops and green manures. Rotations are the changing of crops over both space and time. Well-planned rotation schedules benefit soil fertility, aid in pest management, spread labor needs over time and reduce risks caused by market conditions. Factors such as crop family, plant rooting depths and crop fertility needs should be considered when developing a crop rotation schedule.

Reasons to rotate:

- Enhances soil quality
- Increases soil fertility
- Aids in pest management

Why Rotate?

• Soil quality

Crop rotation practices such as manuring, composting, cover cropping, green manuring and short pasturing cycles improve soil quality by maintaining or increasing soil organic matter content. Organic matter serves as the primary food source for soil microorganisms. These organisms provide many benefits, including holding the soil particles together, releasing minerals for plant uptake, enhancing the downward movement of water and air, and providing pathways for root growth. Rotations including crops with a variety of rooting depths make use of water and nutrients throughout the soil, aid in loosening compacted soil and increase topsoil over time.

• Fertility

Well-planned rotation schedules take into account the preceding year's crops, ensuring that nutrients are available for crops grown the following season. It is important to consider the nutrient needs of each crop to ensure they will be met. The addition of leguminous crops in a rotation can provide nitrogen for following crops. Including crops with a variety of rooting depths allows crops to retrieve water and nutrients not accessed by those grown in previous rotations. Some plants are also effective at making nutrients more available by using less soluble forms, making them accessible for later crops.

• Pest management

Pests are most easily kept in balance when different crops are grown over a number of years. Rotate susceptible crops at intervals to inhibit the buildup of their specific pest organisms. Rotation length should be based on the amount of time soil-borne pathogens remain viable in the field. A four-year rotation using crops not susceptible to the same pathogens will generally minimize problems from soil-borne pathogens, with some exceptions (Table 1). Two years is considered enough time to reduce the incidence of foliar diseases.

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Cropping sequence should be determined based on susceptibility to insect pests. Succeeding crops should have different growth habits and be host to a different set of pests. The primary goal in managing insects through crop rotation is to interfere with the needs of the pest throughout its life cycle. It is therefore important to be familiar with insect life cycles, feeding habits and crop preferences.

The best method of weed control is optimizing crop growth to reduce niches for weeds to develop. Crop rotation helps suppress weeds by using crops that out-compete weeds for water, nutrients or sunlight. Some crops, such as rye or sorghum, release chemicals while growing or decomposing that prevent the seed germination and growth of other nearby plants; this is called allelopathy. The use of cover crops during non-production periods can decrease weed pressure by allelopathy or competition and, when killed and left as a mulch, cover crops can suppress weeds by shading the soil surface.

Rotation strategies:

- Rotate by plant family.
- Rotate by plant part harvested.
- Rotate by plant compatibility.
- Rotate by nutrient requirements.
- Rotate by rooting depth and type.
- Include legumes and cover crops.

How to Rotate

• Planning a rotation

For ease of planning, it is good to design rotational sections of the same size. These sections can then be further subdivided based on production size and land required by each crop, or to incorporate shorter rotational cropping plans. Crops should be divided by family, so the same or closely related crops are not grown in direct succession. It may also prove beneficial to subdivide crops by cultural and management requirements, architectural structure, growth pattern, harvest date, etc. In a short-rotation system, changes should be introduced whenever possible; this may include changes in crop variety or the addition of cool-season cover crops or green manures.

• Legumes

Legumes are an important addition to a crop rotation plan because they fix atmospheric nitrogen, which can be used as a replacement or supplement for inorganic nitrogen fertilizer. The total N contribution varies among species, but 50-200 lbs N/acre can be expected from a good legume cover or cash crop stand. Unlike highly soluble nitrogen fertilizers with a significant potential to leach, N supplied by legume

Table 1.

Rotation lengths to reduce soil-borne pathogens

Vegetable	Disease	Yrs w/o Susceptible Crop
Asparagus	Fusarium rot	8
Cabbage	Clubroot	7
Cabbage	Blackleg	3-4
Cabbage	Black rot	2-3
Muskmelon	Fusarium wilt	5
Parsnip	Root rot	2
Pease	Root canker	3-4
Pease	Fusarium wilt	5
Pumpkin	Black rot	2
Radish	Clubroot	7

crops can be held in soil for extended periods. Approximately 40-75 percent of the N contained in the crop may be available for subsequent plants.

• Cover crops and green manures

Cover crops are also an important component of a crop rotation plan and should be utilized when fields are not being used for production. Cover crops and green manures are those crops grown specifically for the benefits they provide. They may be incorporated into the soil or left as a residue on the soil surface. Their benefits include increased organic matter, improved soil structure, enhanced drought tolerance, increased nutrient availability for plants, protection against soil erosion, weed suppression, penetration of compacted subsoils and nutrient cycling. For more information concerning cover crops, see *Managing Cover Crops Profitably* by SARE, available online at http://www.sare.org/publications/covercrops/covercrops.pdf.

• Crop families

Crops within the same family are generally susceptible to the same insect pests and diseases. A four-year rotation using crops not susceptible to the same pathogens will generally minimize problems from soil-borne pathogens, with some exceptions (Table 1). Two years is considered enough time to reduce the incidence of foliar diseases and insect pests. When planning a rotation, it is often helpful to map out where the crop families listed below will be located and how much of each will be planted:

Poaceae: Corn
Alliaceae: Onion, garlic, shallot, leeks
Chenopodiaceae: Beet, chard, spinach
Cucurbitaceae: Winter and summer squash, cucumber, melon, pumpkin
Brassicaceae: Rutabaga, kale, broccoli, cauliflower, cabbage, Brussels sprouts, radish, mustard, turnip
Fabaceae: Pea, bean
Apiaceae: Carrot, parsley, celery, parsnip
Solanaceae: Potato, tomato, pepper, eggplant
Asteraceae: Lettuce
Convolvulaceae: Sweet potato
Malvaceae: Okra*

*Okra rotates with the *Solanaceae* family

• Compatability

It is important to consider crop compatibility when planning a rotation. Some crops may have beneficial interactions and enhance yield, while others may have detrimental effects to subsequent crops. For example, many crops following the cabbage family may have lower yields. Sweet corn is a good selection to follow the cabbage family because it shows no yield decline. Potatoes are a good crop to follow sweet corn because research has shown sweet corn to be one of the preceding crops that most benefit the yield of potatoes.

For more information on crop rotation, visit http://organics.tennessee.edu. Access "Crop Rotation on Organic Farms: A Planning Manual" (Charles L. Mohler and Sue Ellen Johnson, editors) online at http://www.sare.org/publications/croprotation/croprotation.pdf or request a print copy, available from SARE.

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