



**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**CONSERVATION CROP ROTATION**

(Ac.)

**CODE 328**

**DEFINITION**

A planned sequence of crops grown on the same ground over a period of time (i.e. the rotation cycle).

**PURPOSE**

This practice is applied to support one or more of the following purposes:

- Reduce sheet, rill and wind erosion.
- Maintain or increase soil health and organic matter content.
- Reduce water quality degradation due to excess nutrients.
- Improve soil moisture efficiency.
- Reduce plant pest pressures.
- Provide feed and forage for domestic livestock.
- Provide food and cover habitat for wildlife, including pollinator forage and nesting.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to all cropland where at least one annually-planted crop is included in the crop rotation.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Crops shall be grown in a planned sequence as outlined in Plans and Specifications. The crop rotation shall include a minimum of two different crops. A cover crop is considered a different crop for purposes of this criteria.

Where applicable, plan suitable crop substitutions when the planned crop cannot be planted due to weather, soil conditions, or other local situations.

**Additional Criteria to Reduce Sheet, Rill, and Wind Erosion**

Select crops, a tillage system, and cropping sequences that will produce sufficient and timely quantities of biomass or crop residue which, in conjunction with other practices in the management system, will reduce sheet, rill, and wind erosion to the planned soil loss objective.

Determine the amount of biomass or crop residue needed by using current approved erosion prediction technology. Biomass removal will be managed to retain enough crop residues to limit erosion to acceptable levels.

**Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content**

Grow crops that will produce a positive trend in the Organic Matter (OM) subfactor value over the life of the rotation, as determined by the Soil Conditioning Index (SCI) procedure in the current version of the erosion models. Make appropriate adjustments for additions to or subtractions from biomass.

Planting cover crops in a timely manner will assist in successful stand development in the fall and spring months. Growing increased amounts of plant biomass and leaving residue on the soil surface will protect the soil surface from erosion. Reducing the amount of tillage will promote soil health and protect soil organic matter from runoff and loss.

**Additional Criteria to Reduce Water Quality Degradation Due to Excess Nutrients**

To recover excess nutrients from the soil profile, use crops with:

- Quick germination and root system formation.
- A rooting depth sufficient to reach the nutrients not removed by the previous crop.
- Nutrient requirements that readily utilize the excess nutrients.
- Credit nutrients provided by legumes and manure/compost.

**Additional Criteria to Improve Soil Moisture Efficiency**

Select crops, varieties of crops, and the sequence of crops based on local climate patterns, soil conditions, irrigation water availability, and an approved water balance procedure. Leaving plant residues on the soil surface will allow soil temperatures to moderate and maintain soil moisture during drought stress.

**Additional Criteria to Reduce Plant Pest Pressures**

Design the crop sequence to suppress the pest(s) lifecycle of concern, which may include weeds, insects, and pathogens.

Remove susceptible crops and alternate host crops from the rotation for the period of time needed to break the life cycle of the targeted pest.

Resistant varieties listed in appropriate university publications or other approved sources shall be selected where there is a history of a pest problem.

**Additional Criteria to Provide Feed and Forage for Domestic Livestock**

Select crops that balance the feed supply with livestock numbers. Determine the required amount of selected crops using an approved forage-livestock balance procedure.

Grazing of crops is the desired method of harvesting forage. Cutting silage or hay from crop fields removes nutrients and surface residue protection from fields.

Tillage, planting, and harvest operations will be managed to leave adequate residue for resource protection based on the approved erosion prediction technology.

**Additional Criteria to Provide Food and Habitat for Wildlife, Including Pollinator Forage, and Nesting**

Select the crops and crop management activities that provide either food or cover for the targeted wildlife species using an approved habitat evaluation procedure. Use the “Bobwhite Quail Habitat Appraisal Guide” or the “Cropland Community Model”.

Wildlife habitat guides are located in eFOTG Section IV – Conservation Practices – Upland Wildlife Habitat Management (645) folder. Locate the folder from the below link:

<http://efotg.sc.egov.usda.gov/treemenuFS.aspx>

Leave crop residues undisturbed after harvest (do not shred or bale) to maximize the cover and food source benefits for wildlife.

## CONSIDERATIONS

When used in combination with NRCS Conservation Practice Standard (CPS) Stripcropping (Code 585), the crop sequence should be consistent with the stripcropping design.

Soil compaction can be reduced by adjusting crop rotations to include crops or cover crops with deep roots that extend to and penetrate compacted soil layers. Refer to Appendix 1 - Plant Information tab of the Cover Crop standard (Code 340) for cover crop plant information. Locate the folder from the link below:

<http://efotg.sc.egov.usda.gov/treemenuFS.aspx>

Where improving water use efficiency on deep soils is a concern, rotating or combining deep-rooted crops with shallow rooted crops can help utilize all available water in the soil profile.

Select crops that have the potential to provide larger amounts of biologically fixed nitrogen. Treat the seed with the appropriate inoculum at the time of planting. See Missouri Agronomy Technical Note 36 titled "Legume Inoculation" in Section IV – Conservation Practices – Conservation Crop Rotation (Code 328) folder. Locate the folder from the link below:

<http://efotg.sc.egov.usda.gov/treemenuFS.aspx>

### **Considerations to Reduce Water Quality Degradation Due to Excess Nutrients:**

- Include perennial or annual legume crops in the rotation to provide nitrogen for the non-legume crops, especially in fields where manure applications are restricted by high or excessive soil phosphorus or potassium levels.
- Use carbon/nitrogen ratios of 25:1 to 35:1 for crop residues returned to the soil throughout the rotation. This ratio can build the soil's capacity to provide slow-release N to crops while minimizing N leaching. Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops. Refer to "Carbon to Nitrogen Ratios in Cropping Systems" in Section IV – Conservation Practices – Conservation Crop Rotation (Code 328) folder. Locate the folder from the link: <http://efotg.sc.egov.usda.gov/treemenuFS.aspx>

### **Considerations to Increase Cropping System Diversity**

Minimize the fallow times in the rotation. Where the climate and soils are favorable establish cover crops during the fallow periods.

Cover crops can also add diversity to crop rotations. A diverse mix of cover crops are beneficial to soil organisms and can help reduce soil erosion.

For crop diversity, the planned crop sequence should contain different crop types; for example a mix of the following: warm season grass; warm season broadleaf; cool season grass; cool season broadleaf.

- A two-crop sequence that contains a warm season and a cool season crop.
- A three-crop sequence that contains warm and cool season crops. The same crop species should not be grown in successive years in the same field.
- A four-crop sequence that contains two different crop types, neither should occupy more than half of the sequence.
- Longer crop sequences (four or more years) are more effective with no more than two consecutive years with the same crop.
- Grass crops should alternate with broadleaf crops.

**Considerations to Reduce Sheet and Rill or Wind Erosion.**

When used in combination with NRCS CPSs for Residue and Tillage Management (Codes 329 and 345), select high-residue producing crops and varieties. The use of cover crops, adjustment of plant density, and row spacing can enhance production of the kind, amount, and distribution of residue needed.

When used in combination with NRCS CPSs Stripcropping (Code 585) or Contour Buffer Strips (Code 332) on steeper slopes, the effectiveness of each practice is significantly enhanced by inclusion of the other practice(s) in the conservation system.

Crop damage by wind erosion can be reduced with this practice by selecting crops that are tolerant to abrasion from windblown soil or tolerant to high wind velocity.

**Table 502-1** Crop tolerance to blowing soil

<b>Tolerant T</b>	<b>Moderate tolerance 2 ton/a</b>	<b>Low tolerance 1 ton/a</b>	<b>Very low tolerance 0 to 0.5 ton/a</b>
Barley	Alfalfa (mature)	Broccoli	Alfalfa seedlings
Buckwheat	Corn	Cabbage	Asparagus
Flax	Onions (>30 days)	Cotton	Cantaloupe
Grain Sorghum	Orchard crops	Cucumbers	Carrots
Millet	Soybeans	Garlic	Celery
Oats	Sunflowers	Green/snap beans	Eggplant
Rye	Sweet corn	Lima beans	Flowers
Wheat		Peanuts	Kiwi fruit
		Peas	Lettuce
		Potatoes	Muskmelons
		Sweet potatoes	Onion seedlings (<30 days)
		Tobacco	Peppers
			Spinach
			Squash
			Strawberries
			Sugar beets
			Table beets
			Tomatoes
			Watermelons

*Table 502-1: NRCS National Agronomy Manual 4th Edition 2011*

If crops sensitive to wind erosion damage are grown, the potential for plant damage can be reduced by crop residue management, field windbreaks, cover crops, herbaceous wind barriers, intercropping, or other methods of wind erosion control.

**Considerations to Improve Soil Health**

Consider including perennial sod crops with deep or extensive fibrous root systems to build organic matter throughout the soil profile.

Increase the diversity of cover crops (e.g., mixtures of several plant species) to promote a wider diversity of soil organisms.

Plant legumes or mixtures of legumes with grasses, brassicas, and/or other forbs to provide nitrogen through biological nitrogen fixation.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

Consider leaving sufficient residues to protect the soil surface and conserve moisture throughout the growing season. Reduce the intensity of tillage and increase soil surface coverage with vegetation and crop residues.

The effects of this practice can be enhanced by utilizing animal wastes, cover crops, or applying non-synthetic mulches to supplement the biomass produced by crops in the rotation.

Other considerations for soil health/organic matter management include:

- For at least one-third of the crop sequence (time basis) include high-biomass annual or perennial crops.
- Utilize cover crops and high residue production crops comprising at least one-half of the rotation sequence.
- For rotations dominated by low-residue crops, such as vegetables, include sufficient cover crops and high residue crops for one-half the rotation.

### **Considerations to Reduce Plant Pest Pressures**

Consider lengthening the rotation to include several years of perennial cover to break pest life cycles.

Use a mix of crops from at least three different plant families, and allow three years or longer between successive plantings of production crops within the same family.

Enhance biological pest control by designing the crop rotation to:

- Include flowering annuals or perennials that provide food and habitat for beneficial insects, such as buckwheat, clovers, or phacelia.
- Include plant species that release into the soil natural substances that suppress plant pathogens, nematodes or pests (biofumigation). Examples would be the *Brassica* family and specifically mustards.
- Include crops in the rotation that provide habitat for natural enemies of pests.
- Retain bolting or flowering crops after harvest to provide food for beneficial insects that can prey on non-beneficial insects.

### **Considerations to Provide Food and Cover Habitat for Wildlife, Including Pollinator Forage and Nesting**

Crop residues may be a valuable food source for wintering wildlife where winter browse is sparse. Leaving several rows unharvested around the edges of the field, or planting borders of various forbs will provide protection and/or food for overwintering wildlife and for beneficial insects and pollinators.

Crop plantings may be developed to benefit particular communities, species, or life stages of wildlife. Food plots or crops for wildlife can provide part of a habitat restoration, an initial food and cover for wildlife until food and cover producing vegetation becomes established.

Retaining bolting or flowering crops after harvest can provide beneficial insects with an important food source. Leaving flowering crops go to bloom in the spring is beneficial to insects, especially pollinator species.

Careful consideration should be given to pesticides applied to crops raised for wildlife, particularly if nesting habitat or pollinator forage species are present.

When insect-pollinated crops are part of the rotation, planting the insect-pollinated crop no more than 800 feet from their previous location may help maintain local populations of native bees that have become established because of the presence of that crop.

To maintain stable pollinator and beneficial insect populations, ensure that the same overall density of floral resources is maintained from year-to-year. For example two years of flower-rich plantings, followed by a year of only grasses, will cause a rapid decline in pollinator populations. Such a scenario is undesirable.

## PLANS AND SPECIFICATIONS

Develop plans and specifications for each field or treatment unit according to the Criteria and Operation and Maintenance requirements of this standard. Specifications shall describe the requirements to apply this practice to achieve the intended purpose. Plans and specifications for the establishment and management of conservation crop rotation must be recorded in narrative form on JS-MO328 Conservation Crop Rotation Job Sheet located in Section IV – Conservation Practices – Conservation Crop Rotation (Code 328) folder. Locate the folder from the below link: <http://efotg.sc.egov.usda.gov/treemenuFS.aspx>

The following items will be documented as a minimum.

- Field number and acres
- Purpose(s) of the crop rotation
- The sequence of crops to be grown
- The crop types to be grown
- Tillage type and times
- Length of time each crop/crop type will be grown in the rotation, and
- Total length of rotation
- Suitable crop substitutions to address weather, soil conditions, market, or other situations that may prevent the planned crop from being planted.

## OPERATION AND MAINTENANCE

Rotations shall provide for acceptable substitute crops in case of crop failure or shift in planting intentions for weather related or economic reasons. Acceptable substitutes are crops having similar properties that will accomplish the purpose of the original crop.

Evaluate the rotation and the crop sequence to determine if the planned system is meeting the planned purposes.

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