

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
CONSERVATION CROP ROTATION

(Ac.)

CODE 328

DEFINITION

Growing crops in a planned sequence on the same field.

PURPOSE

This practice may be applied to support one or more of the following:

- Reduce sheet & rill or wind erosion.
- Improve soil quality.
- Manage the balance of plant nutrients.
- Supply nitrogen through biological fixation to reduce energy use
- Manage plant pests (weeds, insects, and diseases).
- Provide feed for domestic livestock.
- Provide annual crops for bioenergy feedstocks.
- Provide food and cover for wildlife, including pollinator forage, cover, and nesting.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land where annual crops are grown, with the exception of pastureland, hayland, or other land uses where annual crops are grown occasionally only to facilitate renovation or re-establishment of perennial vegetation.

For the purposes of this practice, a cover crop (non-harvested crop) is considered a crop in the rotation.

CRITERIA

General Criteria Applicable to All Purposes

Crops shall be grown in a planned sequence as outlined in Plans and Specifications.

Crops shall be adapted to the local climate, the soil resource, and the goals of the producer.

Additional Criteria to Reduce Sheet & Rill or Wind Erosion

The selected crops and cropping sequence, in conjunction with other practices in the management system, shall produce sufficient quantities of biomass, crop residue, and/or intervals without soil disturbance (i.e., perennials) to reduce sheet & rill and/or wind erosion to the planned soil loss objective.

Use the appropriate approved soil erosion prediction technology to verify sheet & rill and/or wind erosion objectives are met.

Additional Criteria to Improve Soil Quality

The selected crops and cropping sequence, in conjunction with other practices in the management system, shall produce sufficient quantities of biomass, crop residue, and/or intervals without soil disturbance (i.e., perennials) to achieve both of the following minimum performance targets for the overall rotation:

1. Predicted sheet & rill erosion must be at or below the soil loss tolerance value (T).
2. The Soil Conditioning Index must predict an SCI score of +0.25 or greater.

See "Considerations" for SCI targets for higher levels of performance.

Additional Criteria to Manage the Balance of Plant Nutrients

Determine crop selection and sequence according to an approved nutrient balance or nutrient management planning procedure.

To reduce excess nutrients such as nitrogen in the soil profile, use crops with:

- quick germination and root system formation,
- a rooting depth sufficient to reach the target nutrients, and
- nutrient requirements that readily utilize the excess nutrients.

Additional Criteria to Supply Nitrogen through Biological Fixation to Reduce Energy Use

When crop rotations are designed to add nitrogen to the system, nitrogen-fixing crops shall be grown immediately prior to or interplanted with nitrogen-requiring crops.

Additional Criteria to Manage Plant Pests (Weeds, Insects, Diseases)

Design crop sequence to break pest lifecycles and/or allow use of a variety of control methods and pesticide modes of action.

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

Additional Criteria to Provide Feed 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.

Additional Criteria to Provide Annual Crops for Biofuel Feedstock

Select crops suitable for the site conditions and the biofuel feedstock objectives.

Additional Criteria to Provide Food and Cover for Wildlife, including Pollinator Forage, Cover, 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.

CONSIDERATIONS

General

This Standard does not apply to hay land or other land in permanent perennials. Nevertheless, including perennials in rotations is not only allowed under this Standard, but should be encouraged. Rotating annual crops with sod-forming grasses or other perennials is one of the most effective ways to achieve key purposes of this Standard, including erosion reduction and soil quality improvement.

This Standard does not apply to permanent pastureland. Controlled, limited grazing of annual and perennial crops and crop residues is allowed under this Standard, however.

Soil compaction can be reduced by selecting crops that produce high amounts of root biomass, by growing crops with root systems that are able to penetrate compacted soil layers, and by avoiding crops that require field operations when soils are generally wet.

Where pesticides are used, cropping sequence and pesticide selection should be managed to avoid negative impacts on subsequent crops due to herbicide carryover and to avoid adverse effects on non-target organisms.

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

Improving Soil Quality

SCI Score

Use the following as a guide for setting Soil Conditioning Index (SCI) targets above +0.25, which is the minimum target under this standard for soil quality improvement:

Soil Conditioning Index (SCI) Score	Performance Level – Soil Quality Improvement
+0.25 to +0.49	Minimum
+0.50 to +0.74	Intermediate
+0.75 or greater	Optimum

Crop Continuity

Maintaining a continuous cycle of living vegetation in the field can enhance soil quality in ways that are not fully accounted for by SCI.

Consider using the following as minimum performance criteria for crop continuity in rotations aimed at improving soil quality. Such rotations may be referred to as Continuous No-Fallow Rotations.

- The crop rotation shall consist of a continuous cycle of living vegetation – grow crops in the field year-round.
- Annual crops shall be promptly harvested after senescence, unless the next crop has already been interseeded and is actively growing.
- Any fallow periods between harvest of one crop and planting of the next crop shall be as short as possible and shall not exceed 60 days.
- The rotation may include perennial as well as annual crops.
- The rotation may include both harvested and non-harvested (cover or green manure) crops.
- Crops shall have stand density, vigor, yield, and seeding and harvest dates consistent with a moderate to high level of management. This applies to harvested and non-harvested crops.
- For purposes of this definition, living vegetation includes adapted perennials with an annual dormant period, such as alfalfa or Bermuda grass.

Crop Diversity

Diversifying crop rotations can enhance soil quality in ways that are not fully accounted for by SCI.

Consider using the following as minimum performance criteria for crop diversity in rotations aimed at improving soil quality. Such rotations may be referred to as High Diversity Rotations.

- The overall crop rotation shall include at least three different crop species, with at least one of those species being a nitrogen-fixing legume.

- Both annual and perennial crops shall be credited towards the species count above.
- Both harvested and non-harvested (cover or green manure crops) shall be credited towards the diversity count above.
- Any crop to be credited towards the diversity count above shall have stand density, vigor, yield, and seeding and harvest dates consistent with a moderate to high level of management. This applies to both harvested and non-harvested crops.
- If any crop to be credited towards the diversity count above is interseeded or grown simultaneously with another crop species, it shall constitute a minimum of 35% of the stand for at least one growing season (in the case of crop mixes containing more than three species grown simultaneously, count only species making up a meaningful proportion of the mix).

Diversity beyond the minimum levels described above can be achieved and should be encouraged. Consider using the following ranges for higher levels of performance in High Diversity Crop Rotations:

Total Species Count		Legume Species Count	Performance Level – Crop Diversity
3 or more	and	1 or more	Minimum
5 or more		2 or more	Intermediate
7 or more		3 or more	Optimum

Soil Disturbance

Minimizing soil disturbance can enhance soil quality in ways that are not fully accounted for by SCI. Soil Tillage Intensity Rating (STIR) provides a useful measure of soil disturbance to complement SCI, with a STIR value of 10 or less representing an optimum to strive for. This applies to STIR values associated with each crop as well as to the average annual STIR value for the overall cropping system.

Rotation to perennials can be effectively used to reduce average annual STIR. For example,

a rotation involving crops established with intensive tillage followed by a significant period in perennial crops can result in a low average annual STIR value for the overall rotation.

Supplying Nitrogen through Biological Fixation to Reduce Energy Use

Select and manage crops to match nitrogen release from residues of nitrogen-fixing crops with nitrogen uptake by subsequent crops, taking into account climate, soil physical and chemical properties, C:N ratio of residues of the nitrogen-fixing crop, and timing of nitrogen demand by the subsequent crop.

Providing Food and Cover for Wildlife and Pollinators

Crop residues can provide valuable food and cover for wildlife. Consider leaving rows of unharvested crop standing at intervals across the field to enhance the value of residues for wildlife food and cover. When managing to benefit a particular wildlife species, consider that species' preference for mowed vs. standing residue.

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

To maintain stable pollinator and beneficial insect populations, consider ensuring 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.

PLANS AND SPECIFICATIONS

Specifications for implementation of this practice shall be prepared for each field or CMU (Conservation Management Unit).

Customize the language and level of detail in specifications as needed for each particular case. Focus above all on providing the client with the practical guidance needed to effectively put the practice on the ground.

Specifications shall be recorded and conveyed to the client using approved job sheets and/or narrative statements in the conservation plan.

Specifications shall at a minimum include all of the following elements:

1. A list of the field(s) and/or CMU(s) where the planned rotation(s) will be applied, along with their acreage.
2. A list of the purpose(s) for which the standard is being implemented (sheet & rill erosion, wind erosion, etc.).
3. A description of the planned crop rotation to include the following elements:
 - Name or type of crop to be grown.
 - Sequence of crops to be grown.
 - Length of time each crop or crop will be grown.
 - Duration of the overall rotation.
4. A description of any additional crop rotation or management that must be carried out in order to achieve relevant additional criteria in this Standard.
5. A description of any complementary practices (conservation tillage, cover crops, etc.) that must be implemented in conjunction with the planned crop rotation in order to achieve soil loss, SCI, or other overall performance criteria required in this Standard.

Use the Conservation Cover Crop practice job sheet to plan and certify this practice.

OPERATION AND MAINTENANCE

Periodically evaluate crop rotation to determine if planned system is achieving desired purposes; make adjustments as needed.

Insert substitute crops into the rotation as needed in response to crop failure or weather- or market-driven changes in planting intentions. Acceptable substitutes are crops that will accomplish the purpose of the originally planned crop.

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