NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA CONSERVATION PRACTICE STANDARD

CONSERVATION CROP ROTATION
(Acre)

CODE 328

DEFINITION

Growing crops in a recurring sequence on the same field.

PURPOSES

This practice may be applied as part of a conservation cropping system to support one or more of the following:

- Reduce sheet and rill erosion.
- Reduce soil erosion from wind.
- Maintain or improve soil organic matter content.
- Manage the balance of plant nutrients.
- Improve water use efficiency.
- Manage plant pests (weeds, insects, and diseases).
- Provide food for domestic livestock.
- Provide food and cover for wildlife.

CONDITIONS WHERE PRACTICE APPLIES

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

CRITERIA

General Criteria Applicable To All Purposes

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

Crops shall be adapted to the climatic region, the soil resource, and the goals of the producer.

A conservation crop rotation may include crops planted for cover or nutrient enhancement.

Crops shall be selected that produce sufficient biomass and/or provide sufficient intervals without soil disturbance (i.e., perennials) to ensure that erosion by water or wind for the overall cropping system is reduced to within acceptable soil loss levels.

Revised Universal Soil Loss Equation, Version 2 (RUSLE2) erosion prediction technology shall be used to assess whether or not a crop rotation provides sufficient biomass and/or sufficient intervals without soil disturbance to ensure that the overall cropping system meets soil loss performance objectives. RUSLE2 calculations shall account for the effects of all management practices (crop rotation, tillage, residue removal, etc.) as well as field-specific factors (climate, soil, topography, etc.) pertinent to the cropping system.

Additional Criteria to Maintain or Improve Soil Organic Matter Content

Crops shall be selected that produce sufficient biomass and/or provide sufficient intervals without soil disturbance to ensure that the overall cropping system achieves the soil loss and Soil Conditioning Index (SCI) criteria listed below.

A cropping system predicted to *maintain* soil organic matter content shall satisfy the following criteria:

1. RUSLE2 must predict a soil loss for conservation planning at or below the soil loss tolerance value (T); and

2. The Soil Conditioning Index must predict an SCI score of 0.00 or greater.

A cropping system that satisfies the above criteria for maintenance of soil organic matter shall be referred to as an Organic Matter Maintenance Cropping System.

A cropping system predicted to *improve* soil organic matter content shall satisfy the following criteria.

1. RUSLE2 must predict a soil loss for conservation planning at or below the soil loss tolerance value (T); and

2. The Soil Conditioning Index must predict an SCI score of +0.25 or greater.

A cropping system that meets these criteria for soil organic matter improvement shall be referred to as an Organic Matter Building Cropping System.

Performance beyond these minimum criteria for soil organic matter maintenance and improvement can be achieved. See "Considerations" for targets for higher levels of performance.

Additional Criteria to Manage the Balance of Plant Nutrients

Crop selection and sequence shall be determined using an approved nutrient balance procedure.

To reduce excess nutrients, crops or cover crops having rooting depths and nutrient requirements that utilize the excess nutrients shall be grown.

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

Crops shall be alternated to break targeted pest life cycles and/or allow for the use of a variety of effective control methods.

Additional Criteria to Provide Food for Domestic Livestock

Crops shall be selected to balance feed supply with livestock numbers. The needed amount of selected crops shall be determined using an approved forage-livestock balance procedure.

Additional Criteria To Provide Food and Cover For Wildlife

Crops that provide either food or cover will be grown, managed, or left unharvested as needed by the targeted wildlife species, shall be determined by an approved habitat evaluation procedure.

CONSIDERATIONS

General

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

Selection of crops to help minimize soil compaction should be encouraged. 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 high-traffic 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 residual herbicides in the soil and to avoid other 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.

Where improving water use efficiency on deep soils is a concern, deep-rooted crops should be rotated or interseeded with shallow rooted crops to utilize all available water in the soil profile.

Maintaining or Improving Soil Organic Matter Content

SCI Score

An SCI score of +0.25 is the lowest level of performance acceptable in an Organic Matter Building Cropping System. The following ranges should be used when setting SCI targets for higher levels of performance:

Soil Conditioning Index (SCI) Score	Performance Level – Soil Organic Matter 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 year-round can enhance soil organic matter and soil quality in ways that are not fully accounted for by SCI score. Continuity of living vegetation also helps fulfill other purposes listed under this standard, including erosion reduction, managing the balance of plant nutrients (through improved cycling and retention), increased wildlife food and cover, etc.

The following should be used as minimum performance criteria for crop rotations that optimize crop continuity for purposes of improving soil organic matter and soil quality. Such rotations are referred to as Continuous No-Fallow Crop Rotations.

- The crop rotation shall consist of a continuous cycle of living vegetation – crops must be grown on 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 bermudagrass.

Crop Diversity

Diversifying crop rotations can enhance soil organic matter and soil quality in ways that are not fully accounted for by SCI score. For example, including nitrogen-fixing legumes in the rotation can be critical to meeting the need for increased soil nitrogen (N) associated with building soil organic matter. Crop diversity also helps fulfill other purposes listed under this standard, including managing the balance of plant nutrients, managing plant pests, etc.

The following should be used as minimum performance criteria for diversifying crop rotations for purposes of improving soil organic matter and soil quality. Rotations satisfying these criteria are referred to as High Diversity Crop 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.

The species count above (at least three species, at least one legume) is the lowest level of performance acceptable in a High Diversity Crop Rotation. Better performance, indicated by increasing number of species in the rotation, can be achieved and should be encouraged. The following ranges should be used when setting targets 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 organic matter and soil quality in ways that are not fully accounted for by SCI Score. Minimizing soil disturbance also helps fulfill other purposes listed under this Standard, in particular erosion reduction.

Regularly rotating to a perennial crop should be encouraged as a way to minimize soil disturbance on cropland, particularly in cropping systems where full-width tillage is used. Soil disturbance can be virtually eliminated without rotating to perennials by continuously no-tilling all crops (see Virginia Conservation Practice Standard *Residue & Tillage Management, No-Till/Strip Till/Direct Seed, Code 329*).

The following are performance criteria that should be used to evaluate cropping systems based on degree of soil disturbance.

- A first key measure of performance involves the tillage system being used. Well-managed continuous no-till is the optimal tillage system for the purpose of soil quality improvement.

- A second key measure of performance involves Soil Tillage Intensity Rating (STIR). In general, cropping systems should be designed so that STIR values are as low as possible. This applies to STIR values associated with each crop as well as to the average annual STIR value for the overall cropping system.

- Producers should be encouraged to strive for an annual average STIR value of 10 or less for the overall cropping system. This is the optimal STIR value for purposes of soil quality improvement.

- Note that crop rotation can be effectively used to reduce average annual STIR. For example, a rotation involving a high-STIR tillage operation followed by a long period in perennial crops can result in a low average annual STIR value.

- Also note that it is possible to meet either of the performance targets described above (continuous no-till and STIR of 10 or less) without achieving the other. A cropping system that qualifies as continuous no-till may not necessarily achieve optimal STIR; optimal STIR can be achieved in certain limited cases in cropping systems that include full-width tillage.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or Conservation Management Unit (CMU). Specifications shall include the following minimum information:

- Rotation duration, in years.
- Sequence of crops to be grown.
- Implementation date.

Additional information shall be included as necessary to ensure that all planned conservation objectives shall be met.

Specifications shall be recorded using approved specification sheets, narrative statements in the Conservation Plan, or other equivalent forms of documentation.

OPERATION AND MAINTENANCE

Planned crop rotations shall allow for substitute crops or cropping sequences in case of crop failures or shifts in planting intentions.

Acceptable substitutes include all crops and crop sequences that allow planned conservation objectives to be met.

REFERENCES

Magdoff, F. and H. van Es. 2000. Building Soils for Better Crops, 2nd Ed. Sustainable Agriculture Network Handbook Series, Book 4.

Reeder, R., et al. 2000. Conservation Tillage Systems and Management: Crop Residue Management with No-till, Ridge-till, Mulch-till, and Strip-till, 2nd Ed. Midwest Plan Service.

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