Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

COVER CROP

CODE 340

(ac)

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

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

- Reduce erosion from wind and water
- Maintain or increase soil health and organic matter content
- Reduce water quality degradation due to excessive soil nutrients
- Suppress excessive weed pressures and break pest cycles
- Improve soil moisture use efficiency
- Minimize soil compaction

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Ensure that cover crop species and management methods are compatible with the producer's objectives, site conditions, and other crops and practices in the farming system.

Ensure that species selection and associated management specifications (seeding rates and dates, fertility requirements, etc.) are consistent with the Plant Establishment Guide for Virginia, Virginia technical notes, or other approved guidance.

Ensure that plants designated as noxious weeds in Virginia shall not be used as cover crops.

Ensure that cover crop residue is not burned.

For non-irrigated cover crops, timing of cover crop termination must be consistent with the attached NRCS Cover Crop Termination Guidelines – Non-Irrigated Cropland. The core requirement applicable to Virginia is that non-irrigated cover crops must be terminated no later than five days after planting of the subsequent crop, but before emergence of the subsequent crop.

Ensure herbicides are compatible with cover crop selections and purpose(s).

When a cover crop will be grazed or hayed, ensure that harvesting will not compromise selected conservation purpose(s).

Do not harvest cover crops for seed.

If the specific rhizobium bacteria for the selected legume cover crop are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Additional Criteria to Reduce Erosion from Wind and Water

Select and manage cover crops to ensure adequate protection of the soil during critical erosion periods.

Current erosion prediction technology shall be used to determine the amount of cover crop biomass and/or residue needed to achieve site-specific erosion reduction objectives.

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

Soil Health

Soil health refers to the amount of living organisms in the soil and their capacity to function, which in turn influences many soil functions. These organisms include bacteria, fungi, protozoa, nematodes, micro-arthropods, earthworms, and plants. They make up the "living" fraction of soil organic matter. For purposes of this Standard, there is no numerical measurement of soil health.

To maintain or increase soil health, select and manage cover crops to maximize implementation of the following soil health principles:

1. Keep soil covered.
2. Minimize soil disturbance, including physical disturbance from tillage and compaction and biochemical disturbance from amendments that may be toxic to soil organisms.
3. Maximize living roots, which refers to maximizing both the amount of living roots in the soil and the amount of time during every year that living roots are present.
4. Maximize biological diversity in the soil, which refers to maximizing not only plant diversity, but diversity of other inputs (manures, compost) and management techniques (managed grazing) that can enhance soil biology.

Maintain or Increase Soil Organic Matter

Soil organic matter refers to the total amount of carbon in the soil (not including mineral or carbonate forms of carbon). Improving soil organic matter content is not the same as improving soil health, although the two are usually closely related.

Selecting and managing cover crops to produce and return to the soil large quantities of above- and below-ground organic material generally increases soil organic matter.

For purposes of this Standard, use the Soil Conditioning Index (SCI) to provide a numerical prediction of soil organic matter trend.

Generating SCI scores requires analysis of the entire cropping system, not just the cover crop selection. This includes inputs for climate and geographic location, topography, and soil type

Ensure that the selected cover crops, in conjunction with other practices in the management system, produce sufficient quantities of biomass, crop residue, and/or intervals without soil disturbance to achieve the following minimum performance targets.

1. A cropping system predicted to *maintain* soil organic matter content over time should have an SCI score of 0.00 or greater and predicted sheet and rill erosion at or below the soil loss tolerance level (T).
2. A cropping system predicted to *improve* soil organic matter content over time should have an SCI score of +0.25 or greater and predicted sheet and rill erosion at or below the soil loss tolerance level (T).

See “Considerations” for SCI targets for higher levels of soil organic matter performance.

Additional Criteria to Reduce Water Quality Degradation Due to Excess Nutrients

Cover crops can reduce loss of excess nutrients to surface water and groundwater through three key mechanisms:

1. By reducing the supply of excess nutrients in the soil.
2. By reducing the need to supply excess nutrients to the soil.
3. By reducing transport potential for excess nutrients from the soil.

To reduce the supply of excess nutrients in the soil, select cover crops with a high uptake capacity for the nutrients of concern and/or a rooting system deep and extensive enough to reach the nutrients of concern. To maximize the total quantity of nutrients captured, terminate cover crops as late as feasible to maximize overall biomass and associated nutrient uptake.

To reduce the need to supply excess nutrients to the soil, select cover crops that help balance crop nutrient needs across the rotation. For example, grow nitrogen-fixing legume crops ahead of grass or other crops with a strong nitrogen (N) need (see also “Considerations”, below).

To reduce runoff and erosion transport potential for excess soil nutrients, select cover crops that increase soil moisture uptake, increase living cover and dead residue on the soil surface, and reduce soil compaction/increase soil porosity.

To reduce the leaching transport potential for excess soil nutrients, select cover crops that maximize crop continuity and uptake of both water and the nutrients of concern before and during critical leaching periods.

Many factors dictate whether nutrients captured or fixed by a cover crop will be available to the subsequent main crop. Among the most important are termination timing, termination method, and C:N ratio of cover crop residues. Take these factors into account when making cover crop management and termination decisions / recommendations.

Additional Criteria to Suppress Excessive Weed Pressures and Break Pest Cycles

Weed Suppression

Select and manage cover crops in order to suppress weeds and/or reduce the weed seed bank through one or more of the following mechanisms:

- Competition for space, light, water, and/or nutrients by actively growing cover crops.
- Physical / mulching effects due to dead cover crop residues.
- Allopathic effects due to chemicals released into the soil by living cover crops and/or dead cover crop residues.

Whenever possible, seed cover crops at high rates to enhance competitiveness with weeds and leave cover crop residues on the soil surface to enhance physical and chemical weed suppression after cover crop termination.

Suppression of Other Pests

Select and manage cover crops in order to suppress insects, pathogens, and other pests through one or more of the following mechanisms:

- Rotation to cover crops that do not serve as hosts to target pest(s) and/or that release substances toxic to target pests (“bio fumigation”).
- Growing cover crops that provide above-ground habitat for beneficial insects and organisms that are antagonistic to pests of the main crop.

- Growing trap-type cover crops that attract pests away from cash crops.

These pest suppression benefits are all associated with cover crops increasing biodiversity within the rotation, within the field, or across the farm. Do not assume that randomly increasing biodiversity with cover crops will suppress key pests. In many cases, cover cropping to suppress insects or disease is very pest-specific and requires careful planning.

Additional Criteria to Improve Soil Moisture Use Efficiency

Select and manage cover crops to either eliminate or conserve soil moisture, as needed by the following crop(s).

To eliminate excess soil moisture, promote maximum cover crop growth and transpiration for as long as possible ahead of planting the following crop.

To conserve soil moisture, strive to maximize the amount of residue that will remain on the soil surface after cover crop termination, while taking into account the need to terminate the cover crop early enough to avoid drying out the soil profile ahead of the next crop.

Additional Criteria to Minimize Soil Compaction

Select and manage cover crop species to improve soil porosity, soil structure, and soil-water-air relations through one or more of the following mechanisms:

- Production of large diameter roots.
- Production of deep roots.
- Production of large quantities of root biomass.

CONSIDERATIONS

General Considerations

A cover crop is a crop planted primarily, but not exclusively, to benefit the soil, the environment, or other crops in the rotation.

Harvesting cover crops for grain or seed is not allowed under this Standard.

Harvesting cover crops for forage or fodder is not prohibited under this Standard, but harvest should not be the primary reason for planting the cover crop.

Whether or not harvesting is appropriate will typically involve a case-by-case determination depending in large part on the purpose(s) for which the cover crop is being grown.

Harvesting will not impair a cover crop's ability to achieve certain purposes, such as late fall and early winter soil nitrogen (N) scavenging by a fall seeded small grain crop. However, harvesting may be incompatible with other cover crop purposes, such as maximizing total soil organic matter returned to the soil surface.

Soil health generally benefits with increasing above-ground biological diversity. Well-managed (i.e., controlled) grazing of cover crops by livestock can be a positive mechanism for increasing biological diversity and associated soil health.

Fertilization, including nitrogen fertilization, of cover crops may be needed depending on site conditions and the purpose(s) for which the cover crop is being grown.

Note that fertilization or harvesting of cover crops may be restricted by NRCS or other cost share programs, guidance, or policy that can be stricter than the minimum criteria of this Standard.

Cover crops may be terminated by tillage, herbicides, harvest, frost, mowing, crimping, natural senescence, or any combination of these methods.

Cover crops typically consist of annual species, but may include biennials and perennials when appropriate. In certain cropping systems, self-reseeding annuals can provide a form of perennial cover crop.

Cover crops are typically seeded after the main crop is harvested and terminated prior to main crop planting. However, intercropping or growing cover crops and main crops simultaneously in the same field is potentially acceptable if it fits the producer's cropping system and the attached NRCS Cover Crop Termination Guidelines.

Do not assume that growing a cover crop will automatically increase performance of the subsequent main crop. Especially for farmers trying new cover crops, careful cover crop selection and management is often essential in order to ensure that the cover crop does not depress subsequent main crop yields.

Cover crops typically have the greatest positive impact on harvested crop yields and overall profitability when they are used for multiple years as part of an integrated cropping system designed to build soil quality and soil fertility and to suppress weeds.

Whenever possible, consider recommending multi-species cover crops which can provide a number of agronomic advantages over monocultures.

Additional Considerations to Maintain or Improve Soil Organic Matter Content

An SCI score of +0.25 is the minimum target under this standard for increasing soil organic matter content. Higher SCI scores can be achieved and should be encouraged. The following are SCI targets for higher levels of soil organic matter performance.

Table 1. Recommended SCI targets.

Soil Conditioning Index (SCI) Score	Performance Level – Increasing Soil Organic Matter Content
+0.25 to +0.49	Minimum
+0.50 to +0.74	Intermediate
+0.75 or greater	Optimum

Additional Considerations to Reduce Water Quality Degradation Due to Excess Nutrients

Growing nitrogen-fixing legume cover crops ahead of grasses and other crops with high nitrogen need can be an effective strategy for reducing nitrogen fertilizer applications, cutting manure applications and associated soil phosphorous buildup, and reducing input costs.

However, planners should be aware that nitrogen in legume residues have the potential to be leached or otherwise lost to the environment almost as readily as fertilizer nitrogen.

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

Where applicable, use an approved nutrient balancing procedure to estimate N credits.

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. Identification / description of the field(s) and/or CMU(s) (including number of acres) where cover crop planting will take place.
2. List of the purpose(s) for which the standard is being implemented.
3. Requirements and/or recommendations for cover crop establishment addressing the following issues, as applicable:
    - Soil testing and fertilization.
    - Method of seeding/planting.
    - Species selection.
    - Quality of seed.
    - Time of seeding.
    - Rate of seeding.
4. Requirements and/or recommendations for cover crop management addressing the following issues, as applicable:
    - Mowing, top-dressing, or other in-season management.
    - Whether harvest is acceptable.
    - Termination method.
    - Termination timing.
    - Management of cover crop residues.
5. A statement of what constitutes successful cover crop establishment and/or management, generally expressed as a target for percent cover and/or biomass production.
6. Any additional recommendations that will increase likelihood of successful practice implementation.

Use the Cover Crop job sheet (IR) to plan and certify this practice.

OPERATION AND MAINTENANCE

Requirements and recommendations for operation and maintenance (O&M) of this practice shall be provided to every client.

Customize the choice of language and level of detail as needed for each particular case. Focus above all on providing the client with the practical guidance needed to ensure the long-term effectiveness of the practice.

O&M recommendations shall be recorded and conveyed using approved job sheets and/or narrative statements in the conservation plan.

Provide at a minimum the following O&M recommendations:

1. Verify that cover crops are established and performing as desired.
2. Reseed as needed or carry out other in-season management such as weed control, fertilization, etc. to ensure performance targets are achieved.

REFERENCES

A. Clark (ed.). 2007. Managing cover crops profitably. 3rd ed. Sustainable Agriculture Network Handbook Series; bk 9.

Hargrove, W.L., ed. Cover crops for clean water. SWCS, 1991.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.

Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

NRCS Cover Crop Termination Guidelines:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

Revised Universal Soil Loss Equation Version 2 (RUSLE2) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/

Wind Erosion Prediction System (WEPS) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.