United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

CONSERVATION CROP ROTATION

CODE 328

(ac)

DEFINITION

A planned sequence of crops grown in the same location over a period of time (e.g., 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 organic matter quantity.
- Improve soil organic matter quality.
- Improve soil aggregate stability.
- Improve habitat for soil organisms.
- Reduce water quality degradation by utilizing excessive soil nutrients.
- Improve moisture management.
- Reduce the concentration of salts from saline seeps.
- Reduce plant pest pressures.
- Provide feed and forage for domestic livestock.

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 must be grown in a planned sequence as outlined below in the Plans and Specifications section. The crop rotation must include a minimum of two different crops. Forage and cover crops are considered a crop when used in the rotation.

Additional Criteria to Reduce Sheet, Rill, and Wind Erosion

The cropping sequence will produce sufficient quantities of aboveground biomass or crop residue during the period(s) of time with the highest erosion rates that, when combined with other practices in the management system, will reduce erosion to the planned soil loss objective.

Determine the amount of aboveground biomass or crop residue needed by using current NRCS erosion prediction technology.

Additional Criteria to Maintain or Increase Soil Organic Matter Quantity

Select crops that produce a positive trend in the soil conditioning index's (SCI) organic matter (OM) subfactor value over the life of the rotation. Make appropriate adjustments for additions or subtractions of biomass.

Additional Criteria to Improve Soil Organic Matter Quality

Restrict fallow periods or periods without living roots in the system to less than 25 percent of the available growing season (e.g., when the ground is capable of sustaining plant growth due to adequate moisture and temperature) in the rotation.

Contain no less than four crop types (see State list) adapted for the region and the rotation to provideasupply of diverse soil organism food.

Include plants with diverse root systems which, in conjunction with other practices in the soil health management system, will provide an increase in the SCI OM subfactor of 0.05 or greater.

Select crops and a cropping sequence that allow minimal soil disturbance.

Additional Criteria to Improve Soil Aggregate Stability

Maximize the number of high-residue crops in the rotation that produce adequate biomass that provide aboveground biomass for lasting cover and sufficient fibrous roots to bind aggregates and support aggregate-building soil organisms.

Crop rotation contains at least one fibrous rooted grass and one legume in conjunction with other practices in the soil health management system.

Select crops and a cropping sequence that allow minimal soil disturbance.

Additional Criteria to Improve Habitat for Soil Organisms

Select no less than four crop types (see State list) adapted for the region and the rotation to provide asupply of diverse soil organism food.

Select crops and a cropping sequence that allow minimal soil disturbance.

Additional Criteria to Reduce Water Quality Degradation Due to Excess Nutrients

Select crops that germinate quickly and form fast-growing root systems to depths sufficient for utilization of nutrients not used by the previous crop. Maximize the time living roots are present in the soil profile throughout the rotation.

Additional Criteria to Improve the Efficiency of Moisture Management

In areas where moisture for crop growth is limited, select crops that require less water to achieve the yield objective.

In areas of potential excess soil moisture, utilize long-lived crops to maximize soil moisture removal.

Additional Criteria to Reduce the Concentration of Salts from Saline Seeps

Select crops to be grown in the recharge area of saline seeps that have rooting depths and water requirements adequate to fully utilize all plant-available soil moisture. Do not use summer fallow. Use an approved water balance procedure to determine crop selection and sequence.

If excess subsoil moisture exists below the rooting depth of crops commonly grown in the recharge area, establish deep-rooted perennial crops for the number of years needed to dry the soil profile.

Select crops with a tolerance to salinity levels that matches the salinity of the discharge area.

Additional Criteria to Reduce Plant Pest Pressures

Design the crop sequence to interrupt the pest's life cycle, allow the use of effective suppression techniques, or provide habitat for beneficial organisms. Use land grant university or industry standards to determine a suitable crop sequence that takes into account plant-pest host associations.

CONSIDERATIONS

General 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 deep-rooting crops to penetrate compacted soil layers.

Where improving water use efficiency on deep soils is a concern, rotate or combine deep-rooted crops with shallow-rooted crops to utilize all available water deeper in the soil profile.

Select crops that have the potential to provide larger amounts of biologically fixed nitrogen.

Considerations to Reduce Sheet, Rill, and Wind Erosion

When used in combination with CPSs Residue and Tillage Management, Reduced Till (Code 345) and Residue and Tillage Management, No-Till (Code 329) selection of high residue-producing crops and varieties, use of cover crops and adjustment of plant density and row spacing can enhance production of the kind, amount, and distribution of residue needed.

Use of CPS Conservation Crop Rotation (Code 328) in combination with CPSs Stripcropping (Code 585), Contour Farming (Code 330), or Contour Buffer Strips (Code 332) on steeper slopes, will significantly enhance the effectiveness of each practice.

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

The potential for plant damage to crops sensitive to wind erosion can be reduced by adopting CPSs Residue and Tillage Management (Codes 329 and 345), Windbreak/Shelterbelt Establishment (Code 380), Herbaceous Wind Barriers (Code 603); 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.

In semiarid regions, where seasonal fallow is used, consider leaving sufficient residues to protect the soil surface during the fallow period, or growing a shallow-rooted cover crop that allows deep moisture storage. Reduce the intensity of tillage and increase soil surface coverage with vegetation and crop residues.

When applying agrichemicals, consider the potential impact on the soil organisms and consult with a pesticide professional to develop alternative application techniques or alternative agrichemicals that have lower adverse impacts on soil organisms.

Select a diverse crop rotation with crops that have shallow, medium, and deep roots to maximize aggregate stability, to increase organic matter, and to improve water infiltration and soil structure.

The effects of this practice can be enhanced by being integrated into a cropping system with at least one practice addressing each of the below-listed key soil health management principles and applicable sub categories:

- Minimize disturbance:
  - Physical.—CPSs Residue and Tillage Management, Reduced Till (Code 345) and Residue and Tillage Management, No-Till (Code 329), Prescribed Grazing (Code 528)
  - Chemical.—CPSs Nutrient Management (Code 590), Pest Management Conservation System (Code 595), Salinity and Sodic Soil Management (Code 610)
  - Biological.—CPSs Cover Crop (Code 340), Prescribed Grazing (Code 528), Forage and Biomass Planting (Code 512), Forage Harvest Management (Code 511)
- Maximize soil cover:
  - Residue.—CPSs Residue and Tillage Management, Reduced Till (Code 345) and Residue and Tillage Management, No-Till (Code 329), Mulching (Code 484)
  - Vegetative.—CPSs Cover Crop (Code 340), Prescribed Grazing (Code 528), Forage and Biomass Planting (Code 512)
- Maximize biodiversity:
  - CPSs Cover Crop (Code 340), Prescribed Grazing (Code 528), Forage and Biomass Planting (Code 512)
- Maximize presence of living roots:
  - CPSs Cover Crop (Code 340), Prescribed Grazing (Code 528), Forage and Biomass Planting (Code 512), Conservation Cover (Code 327)

The effects of this practice can be enhanced by using animal wastes, green manure crops (cover crops), or applying nonsynthetic mulches to supplement the biomass produced by crops in the rotation. Other considerations for soil health/organic matter management include—

- High-biomass annual or perennial crops for at least two-thirds of the crop sequence (time basis).
- Cover crops and high-residue production crops comprising at least one-half of the rotation sequence.

Considerations to Reduce Water Quality Degradation Due to Excess Nutrients

In fields with high or excessive soil phosphorus or potassium levels, include perennial or annual legume crops in the rotation to provide nitrogen for the nonlegume crops in place of manure or synthetic fertilizers.

To build the soil's capacity to provide slow-release nitrogen (N) to crops while minimizing N leaching, maintain crop residues with carbon (C) to N ratios of 25:1 to 35:1 throughout the rotation.

Considerations to Improve Soil Moisture Efficiency

Consider low-water-use crops such as pulse crops, drought tolerant varieties of crops, and the sequence of crops that best fits local climate patterns, soil conditions, irrigation water availability, and an approved water balance procedure.

Considerations to Increase Cropping System Diversity

Minimize or eliminate the fallow periods in the rotation, and plant cover crops during fallow periods where the climate and soils permit.

For crop diversity, the planned crop sequence should contain different crop types (e.g., a mix of warm season grass, warm season broadleaf, cool season grass, and cool season broadleaf) and follow—

- A two-crop sequence that contains two different choices from the following categories:
  - Warm season grass, warm season broadleaf, cool season grass, and cool season broadleaf.
- 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

the sequence.

- Longer crop sequences (4 or more years) are more effective with no more than 2 consecutive years with the same crop.
- Alternate grass crops with broadleaf crops.

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 3 years or longer between successive plantings of production crops within the same family.

Enhance biological pest control by including State-appropriate plants and designing the crop rotation to—

- Include flowering annuals or perennials that provide food and habitat for beneficial insects, such as buckwheat, clovers, or Phacelia. Note: States can replace these examples with State-appropriate examples.
- Include plant species that release natural substances into the soil that suppress plant pathogens, nematodes, or pests (biofumigation). Note: States can include State-appropriate examples.
- Allow crops to bolt or flower after harvest to provide food for beneficial insects. Note: This may also provide a food source for pests.

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 food sources are sparse. Leaving several rows unharvested around the edges of the field, or planting borders of various forbs will provide protection and 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.

Allow crops to bolt or flower after harvest to provide food for beneficial insects. Note: this may also provide a food source for pests.

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

Planting insect-pollinated crops 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 the same overall density of floral resources is maintained from year-to-year. For example, 2 years of flower-rich plantings, followed by a year of only grasses, may lead to smaller pollinator populations.

PLANS AND SPECIFICATIONS

Develop plans and specifications for each field or treatment unit according to the Criteria section requirements above, and operation and maintenance section requirements below. Specifications must describe the requirements to apply this practice to achieve the intended purpose. Record the following specification components in an approved Conservation Crop Rotation (Code 328) implementation requirements document.

- Field number and acres
- Purpose(s) of the crop rotation
- The crop types to be grown

- The sequence of crops to be grown
- Length of time each crop/crop type will be grown in the rotation
- Length of time where no crop/cover crop will be grown in the rotation
- Length of time when the ground is not capable of sustaining plant growth due to inadequate moisture and temperature
- Total length of rotation
- The estimated soil loss for the purpose of reducing sheet, rill, or wind erosion.
- The planned OM subfactor value of the rotation, as determined by the SCI if implementing this practice to maintain or increase OM quantity or quality.
- A list of typical substitute crops (to include cover crops) for use in the rotation to address weather, soil conditions, market, or other situations that may prevent the planned crop from being planted.

OPERATION AND MAINTENANCE

Rotations will 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.

For soil health management systems, (an) approved NRCS assessment procedure(s), for the planned purpose(s), will show (an) improvement in the indicator(s) for which it was planned

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