NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

CONSERVATION CROP ROTATION

(Acre)

CODE 328

DEFINITION

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

PURPOSES

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 the concentration of salts and other chemicals from saline seeps.
- 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

Use of this standard requires compliance with all applicable federal, state, and local laws and regulations.

Crops will be grown in a planned sequence as outlined in Plans and Specifications. The crop rotation will include a minimum of two different crops. For the purposes of these criteria, a cover crop is considered a different crop.

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

Known invasive species will not be used.

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 T or below.

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

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. Make appropriate adjustments for additions to or subtractions from biomass. Refer to the Indiana NRCS Agronomy Technical Note: *Crop Rotations for Soil Quality and Soil Health* for species-specific details and other criteria.

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.

Soil testing according to local land grant university recommendations will be utilized to determine the level of nutrients.

Annual forage mechanically harvested will be removed from the site and the harvested forage will not be fed, or manure will not be applied on the same site from which forage was harvested.

Specific species of plants that will maximize removal of the excess nutrient will be used. Adequate residue cover or regrowth will be maintained to control erosion and minimize loss of nutrients after termination.

Additional Criteria to Improve Soil Moisture Efficiency

Select crops, varieties of crops, and the sequence of crops based on local climate patterns, soil conditions, and irrigation water availability.

Maintain sufficient cover by selecting and managing crop and cover crop species and growth stage to maximize residue cover and residue with high C:N ratio (>40:1) to reduce evapotranspiration and improve water-holding capacity.

Additional Criteria to Reduce the Concentration of Salts and Other Chemicals 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 available soil water. 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 and cover crops with a tolerance to salinity levels that matches the salinity of the discharge area and high residue.

Additional Criteria to Reduce Plant Pest Pressures

Design the crop sequence by rotating crops from different functional groups (e.g. warm season grasses, warm season broadleaves, cool season grasses, and cool season broadleaves) to suppress the pest(s) lifecycle of concern, which may include weeds, insects, and pathogens. Use land grant university or industry standards to determine a suitable crop sequence and resistant varieties.

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.

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.

Establish annual forages that are most capable of supplying the nutritional requirements for the kind and class of the livestock to be fed.

Adequate dry matter will be made available when grazing low C:N ratio species (e.g. brassicas). More mature forages, or hay (with a higher C:N ratio), will be kept

available when grazing low C:N species or include higher carbon species in the mix.

Plant species and their cultivars will be selected based upon:

- animal number, type and weight,
- animal nutritional needs,
- grazing or harvesting intensity,
- height of grazing/harvesting and timing available to provide plants sufficient recovery as needed,
- species and timing of availability is based on forage shortages or gaps,
- and method and timing of harvest.

Select plants that will produce forage for use during periods when other on-farm forage may not meet livestock needs. When herbicides are used they must meet all label requirements for use of forages.

Forage species selected will help balance the dry matter demand of the animals for the desired period of time.

Seedbed preparation, species selection, seeding mixes, seeding rates, dates, depths, fertility requirements, site adaptation and planting methods will be consistent with the requirements in the IN NRCS Seeding Tool and/or Tables in Indiana (IN) Field Office Technical Guide (FOTG) Standard (512) Forage and Biomass Planting.

Forage mechanically harvested will follow IN FOTG Standard (511) Forage Harvest Management requirements. Forage grazed will follow IN FOTG Standard (528) Prescribed Grazing requirements unless planned to be terminated at the end of the grazing period and other planned purposes are not compromised. Soil conditions will be suitable for grazing without compromising other resource concerns.

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, and/or using cover crops to benefit pollinators. Refer to IN NRCS Biology Technical Note: *Upland Wildlife Habitat* and/or *Using Cover Crops to Benefit Pollinators*, and/or IN FOTG Standard (645) Upland Wildlife Habitat Management.

CONSIDERATIONS

The considerations section contains information that is optional to the planner.

When used in combination with IN FOTG Standard (585) Stripcropping, the crop sequence should be consistent with the stripcropping design.

Soil compaction can be reduced by adjusting crop rotations to include deep rooting crops that extend to and penetrate compacted soil layers.

To improve water use efficiency, rotate or combine deep-rooted crops with shallow-rooted crops to use all available water in the soil profile.

Where pesticides are used, use a combination of pesticide application methods and crop rotation to reduce the potential for pesticide carryover or adverse impacts to aquatic and terrestrial wildlife, pollinators, and/or habitat through runoff.

Biological control of various crop pests can be provided by:

- diverse crop rotations,
- the use of field borders with diverse, insect-friendly species,
- intercropping of species that provide forage and nesting resources for beneficial insects.

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

Additional Considerations to Reduce Sheet, Rill or Wind Erosion.

When used in combination with the Residue and Tillage Management practices (IN FOTG Standards 329 and 345), selection of high-residue producing crops and varieties, use of cover crops and adjustment of plant population and row spacing can enhance the production of the kind, amount, and distribution of residue needed.

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.

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

Additional 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.

Consider the use of a continuous no-till (never-till) system to obtain maximum benefits. At a minimum, 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, green manure crops (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 grasses/legumes.
- 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.

Growing high residue crops will have a greater effect on increasing soil organic matter and the Soil Conditioning Index.

Consider utilizing grazing livestock when practical in the system for added synergy of the ruminant flora and increased availability of nutrients. For forage and or residue grazed, refer to IN FOTG Standard (528) Prescribed Grazing requirements unless planned to be terminated at the end of the grazing period and other planned purposes are not compromised.

Diverse warm season cover crop mixes should be considered following wheat where double crop soybeans will not be utilized.

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 ratio of 25:1 to 35:1 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.

Considerations to Increase Cropping System Diversity

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. Also consider:

- 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.

Additional 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, such as buckwheat, clovers, or Phacelia, that provide food and habitat for beneficial insects,

- Include plant species that release natural substances into the soil that suppress plant pathogens, nematodes or pests (biofumigation),
- 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.

Additional Considerations to Provide Feed and Forage for Domestic Livestock

When eliminating existing plants to convert to improved forages for livestock use, select plants that will provide adequate ground cover and root mass to protect soil against wind and water erosion, provide forage that will meet livestock needs, and weed control, in order to provide adequate site conditions for planting new perennial forage.

All herbicides utilized prior to and after establishment must be compatible with forage uses and follow label requirements.

If necessary, more than one year of annual forage may be needed to go along with satisfactorily killing existing perennial cover and control weeds to ensure that a proper site conditions for planting new perennial forage.

Additional 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.

Utilizing diverse cover crop mixes and crop types will increase soil biota and invertebrates which are important protein sources for migrating and resident wildlife species and brood survival.

Retaining bolting or flowering crops after harvest may provide beneficial insects with an important food source.

Careful consideration should be given to nearby pesticide use, particularly if nesting habitat or flowering species for pollinators 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 will describe the requirements to apply this practice to achieve the intended purpose. The following items will be documented as a minimum.

Plans will include the following:

- Plan view,
- 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 or planned no tillage,
- 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. Species of plants to be established.

- Other information pertinent to establishing and managing the species or species of plants to be established.
- If grazed, use a prescribed grazing plan according to NRCS IN FOTG Standard (528) Prescribed Grazing.

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.

Adaptive management of the rotation, crops and support practices will be necessary.

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

Any plant species, whose presence or overpopulation may jeopardize this practice or negatively impact off-site uses, will be controlled. Spraying or other control methods will be performed on a “spot” basis to protect forbs/legumes that benefit native pollinators and other wildlife.

REFERENCES

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