**NATURAL RESOURCES CONSERVATION SERVICE**

**CONSERVATION PRACTICE STANDARD**

# CONSERVATION CROP ROTATION

**(Ac.)**

**CODE 328**

## DEFINITION

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

Grow crops in a planned sequence as outlined in the **Plans and Specifications** section. The crop rotation needs to include a minimum of two different crops. For 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.

See Florida Conservation Practice Standard Conservation Crop Rotation, Code 328, Guidance for additional information. Refer to University of Florida, Institute of Food and Sciences (UF, IFAS) publications or other approved sources, to select adapted crops and varieties.

Avoid or minimize, to the extent practical, impact to cultural resources, wetlands, and Federal and State protected species during planning, design and implementation of this conservation practice. For more information, see National and Florida NRCS policy, General Manual (GM) Title 420-Part 401, Title 450-Part 401, and Title 190-Parts 410.22 and 410.26; National Planning Procedures Handbook (NPPH, Handbooks Title 180 Part 600) FL Supplements to Parts 600.1 and 600.6; National Cultural Resources Procedures Handbook (NCRPH, Handbooks Title 190 Part 601); and The National Environmental Compliance Handbook (NECH, Handbooks Title 180 Part 610).

**Additional Criteria to Reduce Sheet, Rill and Wind Erosion**

Select crops, 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 the planned soil loss objective.

Determine the amount of biomass or crop residue needed by using current NRCS 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 (SCI). Make appropriate adjustments for additions to or subtractions from biomass.

Cover and green manure crops planted specifically for soil improvement may be grazed, as long as grazing is managed to retain adequate above ground biomass to meet desired soil organic matter goal.

Establishing a perennial grass cover as part of a crop rotation system for a minimum of two years will improve the soil organic matter content. Following the two year period in grass, the rotation would return to cropping. An example of this sod-based rotation would be: Peanut-Cotton-Bahiagrass-Bahiagrass. For more information on this rotation see UF, IFAS SS-AGR-124. See the Florida Conservation Practice Standard Forage and Biomass, Code 512, for proper methods and techniques for establishing perennial grasses within crop rotations.

**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, and
- Nutrient requirements that readily utilize the excess nutrients.

- Credit nutrients provided by legumes and manure/compost.

Florida Agronomy Field Handbook (FAFH) and Agricultural Waste Management Field Handbook (AWMFH) may be used to develop the selection and sequence.

**Additional Criteria to Improve Soil Moisture Efficiency**

Select crops, varieties of crops, and the sequence of crops based on local climate patterns, soil conditions, irrigation water availability, and an approved water balance procedure. Where irrigation is used, apply irrigation water management in accordance with Florida NRCS Conservation Practice Standard, Irrigation Water Management, Code 449.

**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 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 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.

Select resistant varieties when there is a history of a pest problem. Publications from UF, IFAS may be used as a source for these varieties.

Establishing a perennial grass cover as part of a crop rotation system for one to two years will reduce soil pests, such as root-knot nematode in peanuts. Following the one or two years in grass the rotation would return to cropping. See UF, IFAS CIR 1260 for more information. See the Florida Conservation Practice Standard Forage and Biomass Planting, Code 512, for proper methods and techniques for establishing perennial grass within the crop rotation.

**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.

**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 using an approved habitat evaluation procedure.

Selection and management of unharvested crops will be consistent with the Florida NRCS Conservation Practice Standard Upland Wildlife Habitat Management, Code 645, and accompanying Guidance and Specification.

**CONSIDERATIONS**

When used in combination with Florida NRCS Conservation Practice 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 with deep roots that extend to and penetrate compacted soil layers.

Where improving water use efficiency on deep soils is a concern, rotating or combining deep-rooted crops with shallow rooted crops can help utilize all available water in the soil profile.

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

**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**

Minimize the fallow years in the rotation and where the climate and soils are favorable establish cover crops during the fallow periods.

For crop diversity, the planned crop sequence should contain different crop types for example a mix of warm season grass, warm season broadleaf, cool season grass, and cool season broadleaf. The following are possible cropping sequences to enhance diversity:

- 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;
- In subtropical regions, such as Florida, or regions with distinct wet and dry seasons (Mediterranean climate), grass crops should alternate with broadleaf crops.

**Additional Considerations to Reduce Sheet and Rill or Wind Erosion.**

When used in combination with Florida NRCS Conservation Practice Standards for Residue and Tillage Management, Codes 329 and 345, 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.

When used in combination with FL NRCS Conservation Practice Standards Stripcropping, Code 585, or Contour Buffer Strips, Code 332, on steeper slopes, the effectiveness of each practice is significantly enhanced by inclusion of the other practice(s) in the conservation system.

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.

In semiarid regions, where seasonal fallow is often used to store moisture in the soil for a subsequent crop, consider leaving sufficient residues to protect the soil surface during fallow, 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.

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 crops.
- 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.

**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 that provide food and habitat for beneficial insects, such as buckwheat, clovers, or Phacelia.
- Include plant species that release into the soil natural substances 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.

For more information on biological control in Florida see UF, IFAS Electronic Data Information System subtopic on Biological Control.

**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.

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

Careful consideration should be given to pesticides applied to crops raised for wildlife, particularly if nesting habitat or pollinator forage species 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 shall describe the requirements to apply this practice to achieve the intended purpose. Record the following specification components in an approved FL NRCS CPS Conservation Crop Rotation, 328, Implementation Requirements document. The following items will be documented as a minimum.

- 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,
- 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.

**OPERATION AND MAINTENANCE**

Rotations shall 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.

**REFERENCES**

Green, B., D. Kaminski, B. Rapp, M. Celetti, D. Derksen, L. Juras, and D. Kelner. 2005. Principles and practices of crop rotation. Saskatchewan Agriculture and Food.

Karlen, D.L., E.G. Hurley, S.S. Andrews, C.A. Cambardella, D.W. Meek, M.D. Duffy, and A.P. Mallorino. 2006. Crop rotation effects on soil quality at three northern corn/soybean belt locations. Agron. J. 98:484-495.

Liebig, M.A., D.L. Tanaka, J.M. Krupinsky, S.D. Merrill, and J.D. Hanson. 2007. Dynamic cropping systems: Contributions to improve agroecosystem sustainability. Agron. J. 99:899-903.

Sherrod, L.A., G.A. Peterson, D.G. Westfall, and L.R. Ahuja. 2003. Cropping intensity enhances soil organic carbon and nitrogen in a no-till agroecosystem. Agron. J. 67:1533-1543.

USDA-AMS National Organic Program Final Rule 7 CFR Part 205. http://www.ams.usda.gov/AMSv1.0/nop.

USDA, NRCS. 2014. Revised Universal Soil Loss Equation Version 2 (RUSLE2) website: Washington, DC. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/

USDA, NRCS. 2014. Wind Erosion Prediction System (WEPS) website: Washington, DC. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

USDA, NRCS. 2011. National Agronomy Manual, 4th Ed. Washington, DC. http://directives.sc.egov.usda.gov/viewerFS.aspx?hid=29606

USDA, NRCS. 2014. Preventing or mitigating potential negative impacts of pesticides on pollinators using IPM and other conservation practices. Nat. Agron. Tech Note 9. Washington, DC. http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=34828.wba