NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

CONSERVATION CROP ROTATION

(Ac.)

CODE 328

DEFINITION

Growing crops in a planned sequence on the same field.

PURPOSE

This practice may be applied to support one or more of the following:

- Reduce sheet-and-rill or wind erosion.
- Improve soil quality.
- Manage the balance of plant nutrients.
- Supply nitrogen through biological nitrogen fixation to reduce energy use
- Conserve water.
- Manage saline seeps.
- Manage plant pests (weeds, insects, and diseases).
- Provide feed for domestic livestock.
- Provide annual crops for bioenergy feedstocks.
- Provide food and cover for wildlife, including pollinator forage, cover, and nesting.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland where annually-planted crops make up at least one-third of the crop sequence (time basis).

For the purposes of this practice, a cover crop is considered a crop in the rotation.

CRITERIA

General Criteria Applicable to All Purposes

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

Additional Criteria to Reduce Water or Wind Erosion

The selected crops and the cropping sequence shall produce sufficient and timely quantities of biomass or crop residue, in conjunction with other practices in the management system, to reduce sheet and rill and/or wind erosion to the planned soil loss objective.

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

Additional Criteria to Improve Soil Quality

The crops grown shall produce a positive OM (Organic Matter) subfactor value over the life of the rotation, as determined by the Soil Conditioning Index, with appropriate adjustments for additions to or subtractions from biomass.

Additional Criteria to Manage the Balance of Plant Nutrients

Determine crop selection and sequence according to an approved nutrient balance procedure.

To reduce excess nutrients in 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.

Additional Criteria to Supply Nitrogen Through Biological Nitrogen Fixation to Reduce Energy Use

When crop rotations are designed to add nitrogen to the system, nitrogen-fixing crops

shall be grown immediately prior to or interplanted with crops having extensive nitrogen requirements.

Additional Criteria to Conserve Water

Select crops and varieties and the sequence of crops based on local climate potential and/or irrigation water availability, and an approved water balance procedure.

Additional Criteria to Manage 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. Crop selection and sequence shall be determined using an approved water balance procedure.

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

Crops grown in the discharge area of saline seeps shall be selected with a tolerance to salinity levels that matches the salinity of the discharge area.

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

Design the crop sequence to break pest lifecycles and/or to allow the use of a variety of control methods.

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.

Resistant varieties, listed in appropriate Land Grant University publications or other approved sources, shall be selected where there is a history of pest problems.

Additional Criteria to Provide Feed 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 Annual Crops for Biofuel Feedstock.

Select crops suitable for the site conditions and the biofuel feedstock objectives.

Additional Criteria to Provide Food and Cover for Wildlife

Select the crops and crop management activities that provide either food or cover for the targeted wildlife species using an approved habitat evaluation procedure.

CONSIDERATIONS

When used in combination with Stripcropping (practice code 585), the crop sequence should be consistent with the stripcropping design.

Soil compaction can be reduced by adjusting crop rotations to include 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.

Where pesticides are used, use a combination of pesticide application methods and crop rotation to reduce the potential for pesticide carryover or adverse affects on aquatic wildlife or habitat through runoff. Consider using practice Integrated Pest Management (595).

Additional Considerations to Increase Cropping System Diversity

Fallow years should not occupy more than 25% of the planned crop sequence ("fallow year" means a time that cropland is uncropped during a growing season, vegetative growth is controlled by tillage or herbicides).

For crop diversity, the planned crop sequence should contain different crop types such as: [crop types are: warm season grass (WSG); warm season broadleaf (WSB); cool season grass (CSG); cool season broadleaf (CSB)]:

- 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, neither should be grown in consecutive years;
- A four-crop sequence that contains two different crop types, neither should occupy more than half of the sequence;
- Longer crop sequences may have more than two consecutive years of the same crop type, as long as that crop type does

not occupy more than ⅔ of the crop rotation;

- In regions with distinct wet and dry seasons (like interior Alaska), grass crops should alternate with broadleaf crops according to rainfall patterns.

Additional Considerations to Reduce Sheet and Rill or Wind Erosion.

When used in combination with the Residue and Tillage Management practices (like practice codes 329and 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.

Crop damage by wind erosion can be reduced with this practice by selecting crops that are tolerant to abrasion from wind blown 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 Quality

Soil organic matter levels are more sensitive to tillage than to long rotations with perennial vegetation. Therefore, reducing or eliminating tillage from a management system will increase soil organic matter quicker than rotations with several years of perennial vegetation.

The effects of this practice can be enhanced by utilizing animal wastes, including green manure crops (cover crops), or applying mulches to supplement the biomass produced by crops in the rotation.

Additional Considerations to Supply Plant Produced Nitrogen to Conserve Energy

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

When crop rotations are designed to add nitrogen to the system, nitrogen-fixing crops shall be grown immediately prior to or interplanted with nitrogen-requiring crops.

Select crop and management strategies to match nitrogen release from residues of nitrogen fixing crop with nitrogen uptake by subsequent crop, taking into account climate, soil physical and chemical properties, C:N ratio of residues of the nitrogen fixing crop, and timing of nitrogen demand by the subsequent crop.

Additional Considerations for Wildlife, Beneficial Insects, and Pollinators

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 when and where pests are active.

Biological control of various crop pests can be provided by:

- crop rotations that include plant species that provide habitat for beneficial insects such as buckwheat or *Phacelia;*
- the use of plant species that produce chemical substances that control nematodes or other disease causing organisms (allelopathy)
- the use of insectory field borders, and
- intercropping of species that provide forage and nesting resources for beneficial insects.

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 them 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

Plans and specifications shall include:

- field number and acres
- purpose(s) of the crop rotation
- the sequence of crops to be grown,
- the crop types to be grown
- length of time each crop/crop type will be grown in the rotation, and
- total length of rotation

Specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

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, NRCS. 2009. Web Soil Survey. Available (checked apr 2014) at http://websoilsurvey.nrcs.usda.gov.