

Conservation Crop Rotation (Ac) (328)

PURPOSES

To grow crops in a planned sequence on the same field. 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 plant pests (weeds, insects, and diseases).
- Provide feed for domestic livestock.
- Provide annual crops for bioenergy feed stocks.
- 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 the Revised Universal Soil Loss Equation (Rusle 2) *model to predict water erosion estimates* or latest Wind Erosion Prediction System model (WEPS) to predict wind erosion estimates.

Calculations shall account for the effects of other practices (such as addition of manure with bedding or cover crops) in the resource management system.

Additional Criteria to Improve Soil Quality

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

The SCI is in the NRCS RUSLE 2 and the (WEPS) model or more detailed instructions are available in the NRCS National Agronomy Manual part 508 Soils, Subpart 508C Soil Management, Soil Conditioning Index sections.508.3-508.37.

Additional Criteria to Manage the Balance of Plant Nutrients

Determine crop selection and sequence using the MI Farm Nutrient Balance Spreadsheet in the MI NRCS eFOTG Section IV practice standard 590 under Nutrient Management References.

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;
- 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 inter-planted with nitrogen requiring crops.

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. See the NRCS MI 449 Irrigation Water Management standard for irrigation scheduling specifications and guidance.

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

Design the crop sequence to break pest lifecycles and/or to allow for 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 university publications or other approved sources, shall be selected where there is a history of a pest problem. MSUE publications for reference include:

1. E2704 Michigan Field Crop Pest Ecology & Management
2. E2646 Michigan Field Crop Ecology

Additional Criteria to Provide Food for Domestic Livestock

Select crops that balance the feed supply with livestock numbers. Determine the required amount of selected crops using the NRCS MI Rotational Grazing Inventory Spreadsheet filed in the Michigan EFOTG as *Grazing Technical Note 3, Designing a Prescribed Grazing System*, to balance feed and livestock numbers.

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 the Michigan Habitat Index, Biology Technical Note Number 12, and July, 1993 as a design reference.

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 deep rooted crops that are able to extend to and penetrate the compacted soil layers. See the NRCS *eFOTG Agronomy Technical Notes 48, 49, 50 & 51 for more information on cover crops to remove soil compaction before converting to No-till.*

Narrow Stripcropping can be used with a crop rotation to implement a poor man's controlled traffic guidance system. See the NRCS MI EFOTG Agronomy Technical Notes 41 & 42 on using Narrow Stripcropping to aid in reducing soil compaction.

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.

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 not cropped during a growing season and vegetative growth is controlled by tillage or herbicides).

For crop diversity the planned crop sequence will contain different crop types, specified below [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 a warm season 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.*

Additional Considerations to Reduce Sheet and Rill or Wind Erosion

When used in combination with Residue and Tillage Management, practices (practice codes 329, 345, and 346) selection of high residue producing crops and varieties, the 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. *See the crop tolerance table in the wind erosion prediction section of the MI NRCS eFOTG for crop tolerance to wind erosion in tons/ac/yr.*

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 inter-planted with nitrogen-requiring crops.

Select crop and management strategy 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 not harvested 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 for some time 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*
- inter-cropping 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 become 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.

See the MSUE *Bulletin E-2107, Seeding Practices for Michigan Crops*, for a list of common crops adapted to Michigan.

Long Term No till and crop rotation systems can increase surface organic matter in soils and thus reduce sheet and rill erosion. For example, 50 years of No till research at the Ohio State Hoytville and Wooster research stations has resulted in a 4-5% soil organic matter level with a corn soybean crop rotation.

Manure with straw bedding in crop rotations with tillage also, can maintain or raise organic matter levels in soil. See NRCS MI Agronomy Tech Note 29, Understanding Soil Organic Matter Changes.

If wheat or other small grains are inter-seeded in low residue producing crops such as soybeans or dry beans, follow guidelines in the *NRCS MI Agronomy Technical Note 52 Aerial Seeding and the Cover Crop Standard (340)*

If partial removal of residue by means such as baling or grazing occurs, enough crop residues shall be maintained to achieve the desired soil organic matter content goal.

Cover and green manure crops planted specifically for soil improvement may be grazed, as long as grazing is managed to retain adequate biomass following an approved modeling procedure.

Where pesticide loss is a resource concern, consider use of a crop rotation that substitute traditionally low pesticide use crops, such as alfalfa or small grains, for high pesticide use crops (corn, sugar beets, and potatoes). Or use lower rate pesticides such as Lightning on Clearfield corn rather than Atrazine on field corn.

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.

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