Conservation Crop Rotation
(Ac.) 328

DEFINITION

Growing crops in a *planned* sequence on the same field.

PURPOSES

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;
- *Increase cropping system diversity;*
- *Manage crop consumptive use of water;*
- Manage plant pests (weeds, insects, and diseases);
- Provide food for domestic livestock;
- *Provide food and cover for wildlife, including pollinator forage, cover, and nesting.*

CONDITIONS - PRACTICE APPLIES

This practice applies to all land where annually-planted crops make up at least one-third of the crop sequence.

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.

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) procedure, with appropriate adjustments for additions to or subtractions from biomass on the field. The SCI is found in the NRCS water erosion prediction model RUSLE 2 or detailed instructions in the National Agronomy Manual part 508 subpart 508C.

Additional Criteria to Reduce Water or Wind Erosion

The selected crops and the planned sequence shall produce sufficient quantities of biomass or crop residue at the appropriate times so that, when accounting for other practices in the management system, sheet and rill and/or wind erosion is reduced to the planned soil loss objective for the planning area.

The amount of biomass or crop residue needed shall be determined using the Revised Universal Soil Loss Equation (Rusle 2) model or latest Wind Erosion Prediction model (WEPS) to predict wind erosion estimates.

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

Additional Criteria to Improve Soil Quality

Fallow years shall not occupy more than 25% of the planned crop sequence. (For this practice, "fallow year" means a time that cropland is not cropped during a growing season, and on which vegetative growth is controlled by tillage or herbicides.)
The planned crop sequence will contain different crop types as 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 must contain a warm season and a cool season crop;*
- *A three-crop sequence must contain a warm season and a cool season crop, neither of which may be grown in consecutive years;*
- *A four-crop sequence must contain two different crop types, neither of which may 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 tropical regions or regions with distinct wet and dry seasons (Mediterranean climate), alternate grass crops with broadleaf crops.

Additional Criteria to Manage the Balance of Plant Nutrients

Crop selection and sequence shall be determined using an approved nutrient balance procedure. *(See the MI Farm Nutrient Balance Spreadsheet in Section IV of the MI NRCS eFOTG under CNMP Technical Tools.)*

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 such that they can readily utilize the excess nutrients.*

Additional Criteria to Manage Crop Consumptive Use of Water

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

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. *See the NRCS MI Rotational Grazing Inventory Spreadsheet filed in the Michigan EFOTG Agronomy Technical Note Instructions on how to balance feed and livestock numbers.*

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.

Narrow Stripcropping can be used with a crop rotation to implement a poor man's controlled traffic guidance system (see NRCS MI EFOTG/ Sec.1 /General Resource References/ Reference material/MI Technical Notes/ Agronomy 41 & 42 for more information on 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 Criteria to Reduce Sheet and Rill or Wind Erosion

When used in combination with Residue 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 population 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 MI NRCS EFOTG /Section I\General Resource References\Erosion Prediction\Wind Erosion/Table for a list of crops 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, applying mulches to supplement the biomass produced by crops in the rotation *or growing cover crops in the cropping sequence.*

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 could be provided as part of a habitat restoration project as an initial food and cover source 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 nectar source when and where pests are active.

Biological control of various crop pests can be provided by:

- *crop rotations that include forbs such as buckwheat or Phacelia;*
- *the use of insect attractive field border;*
- *inter-cropping of species that provide forage and nesting resources for beneficial insects.*

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

Consider using crop varieties in rotation such as Bt corn, leafhopper-resistant alfalfa, Glyphosate-tolerant corn or soybeans to reduce pesticide or herbicide use and prevent harm to wildlife or the environment.

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.

Where pesticides are used, consider application methods and the crop rotation to avoid negative impacts on the following

crop due to residual herbicides in the soil or adverse effects on aquatic wildlife or habitat through runoff.

See the MSUE Annual On-Farm Research and Demonstration Report, or MSUE Bulletin E-2107, Seeding Practices for Michigan Crops, and eFOTG Agronomy Reference File for lists 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 has resulted in a 4-5% Organic matter level at the surface in soils at the Hoytville and Wooster, Ohio Experiment Stations under a corn soybean crop rotation.

Straw manure 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, MSU Research Report 358, (RR 358) Soil Organic Matter Dynamics (1978, Lucas and Vitosh).

If wheat or other small grains are inter-seeded in low residue producing crops such as soybeans or dry beans, follow guidelines in MI Agronomy Technical Note #31 Aerial Seeding Cover Crops and Small Grains and the NRCS MI 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 meet the criteria for all the resource concerns identified for the field or treatment unit.

REFERENCES

Lucas, R.E., and Vitosh, M.L., 1978. MSUE RR 358, Soil Organic Matter Dynamics.

NRCS MI EFOTG Agronomy Tech Note 8, Transitioning to Organic Resources. 2006.

NRCS MI EFOTG Agronomy Tech Note 29, Understanding Soil Organic Matter Changes 1993.

NRCS MI EFOTG Agronomy Tech Note 41 Narrow Strip Cropping October 2009.

NRCS MI EFOTG Agronomy Tech Note 42 Controlled Release N on Corn in Narrow Strip Cropping October 2009.

Warncke D., J. Dahl, L.W. Jacobs, C. Laboski 2004. *Nutrient Recommendations for Field Crops in Michigan.* MSUE Bulletin E2904.

Warncke D., J. Dahl, L.W. Jacobs, C. Laboski 2004. Nutrient Recommendations for Vegetable Crops in Michigan. MSUE Bulletin E2934.