

## Cover Crop (Ac.) 340

Bulletin E-2646, Michigan Field Crop Ecology and other recently published MSUE Bulletins, etc.

Also sowing cover crops in marginal areas could have many benefits see NRCS Michigan Agronomy Tech Note 49 Cover Crops on the Edge and NRCS MI Agronomy Tech Note 54 Michigan Cover Crop Management.

### DEFINITION

Cover crops include grasses, legumes, and forbs, established for seasonal cover and other conservation purposes.

### PURPOSES

- Reduce erosion from wind and water
- Increase soil organic matter content
- Capture and recycle or redistribute nutrients in the soil profile
- Promote biological nitrogen fixation and reduce energy use.
- Increase biodiversity
- Suppress weeds
- Manage soil structure
- Minimize and reduce soil compaction
- Reduce pest pressure
- Encourage Pollination

### CONDITIONS WHERE PRACTICE APPLIES

All lands requiring vegetative cover for natural resource protection and or improvement

This standard provides guidelines for the selection of cover crops to address single or multiple resource concerns. It supports the principals and recommendations found in Michigan State University (MSU)-Extension

### CRITERIA

#### General Criteria Applicable To All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, and planting methods will be consistent with approved local criteria and site conditions (see Table 1 and 2) following row crops, vegetables, small grains, summer cover, and conservation use land.

Use weed-free and disease-free seed and establish cover crops by one of the following methods: over-seeding, frost seeding, aerial seeding, broadcast seeding, air-flow broadcasting, drilling or manure slurry seeding following MSUE recommendations. Aerial seeding of cover crops shall follow the requirements of the NRCS Michigan Agronomy Technical Note 52, Aerial Seeding of Cover Crops.

The species selected will be compatible with other components of the cropping system.

Cover crops will be terminated by harvest, frost, mowing, tillage, crimping, and/or herbicide depending on the resource concern used to justify the cover crop.

Ensure herbicides used with cover crops are compatible with the following crop.

Ensure that plants are not listed as noxious weeds or invasive species on the Michigan noxious weed or invasive species list.

Cover crop residue will not be burned.

*In addition to other criteria for non-irrigated cover crop termination, the cover crop termination must be at or before the time periods specified in the attached: NRCS Cover Crop termination Guidelines-Non-Irrigated Cropland).*

### **Additional Criteria to Reduce Erosion from Wind and Water**

Time cover crop establishment, in conjunction with other practices, so that the soil will be adequately protected during the critical erosion period(s).

Plants selected for cover crops will have the physical characteristics necessary to provide adequate protection (see Table 1).

Determine the amount of surface and/or canopy cover needed from the cover crop needed using the Revised Universal Soil Loss Equation (RUSLE 2) or Wind Erosion Prediction System (WEPS) models. See Section I of the local NRCS Michigan eFOTG for instructions on using these models

Inter seed small grain cover crops in rows with row or vegetable crops to reduce wind erosion losses to the atmosphere and protect young seedlings from wind erosion saltation (abrasion) damage.

### **Additional Criteria to Increase Soil Organic Matter Content**

Cover crop species will be selected on the basis of producing high volumes of organic material and or root mass to maintain or improve soil organic matter.

The NRCS Soil Conditioning Index (SCI) procedure found in RUSLE2 or WEPS model shall be used to determine the amount of biomass to have a positive trend in the soil organic matter sub factor.

The cover crop shall be planted as early as possible and be terminated as late as feasible to maximize plant biomass production, considering crop insurance criteria the time needed to prepare the field for planting the next crop, and soil moisture depletion.

### **Additional Criteria to Capture and Recycle or Redistribute Excess Nutrients in the Soil Profile**

Cover crops will be established and actively growing before expected period(s) of nutrient leaching.

Select cover crop species for their ability to take up large amounts of nutrients from the rooting profile of the soil.

Terminate the cover crop as late as feasible to maximize plant biomass production. Consider the time needed to prepare the seedbed for planting the next crop and soil moisture depletion.

Cover crops to capture nutrients have many benefits. See the NRCS MI Agronomy Technical Note 46, ` Buckwheat a Phosphorus Pump; Agronomy Tech Note 47, Squeezing More Value from Manure with Cover Crops and Agronomy Tech Note 50 Oilseed Radish Cover Crop.

### **Additional Criteria to Promote Biological Nitrogen Fixation**

Use legumes or legume-grass mixtures to establish cover crops.

The specific Rhizobia bacteria will either be present in the soil or the seed will be inoculated at the time of planting legumes.

#### **Additional Criteria to Increase Biodiversity**

Select cover crop species to achieve one or more of the following: species mix with different maturity dates, attract beneficial insects, serve as a trap crop from damaging insects, and/or provide food and cover for wildlife habitat management. See NRCS Michigan, eFOTG, Section IV, Conservation Buffers and Beneficial Insects, Mites, and Spiders.

#### **Additional Criteria for Weed Suppression**

Species for cover crops will be selected for their chemical or physical characteristics to suppress or compete with weeds.

Higher seeding rates to provide additional cover will help control weeds to eliminate or reduce herbicide use.

Cover crop residues will be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

If the objective is to use a cover crop as a bio-control a late kill may be used.

For long-term weed suppression, including on sites to be planted to trees and /or shrubs, perennials and/or biennial species can be used.

Cover crops for forest tree/tree shrub establishment sites shall be one of the following: white clover, redtop, Virginia Wildrye, Canada Wildrye (on upland landscapes), or Riverbank Wildrye (on floodplain or other lowland sites). The three Wildrye species are native to Michigan and are preferred for forest restoration plantings.

Cover crops for tree/shrub establishment shall control weeds in the areas between trees; however, cover crops are not a substitute for proper weed control in the areas adjacent to the trees and shrubs. Maintain at least an 18” radius zone around each seedling that is vegetation free. See the NRCS MI Tree/Shrub Establishment (612) and Tree/Shrub Site Preparation practice (490) standards for more information.

#### **Additional Criteria for Soil Moisture Management**

Terminate growth of cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

#### **Additional Criteria to Minimize and Reduce Soil Compaction**

Select and manage cover crop species that will produce deep roots and large amounts of surface or root biomass to increase soil organic matter, improve soil structure and increase soil moisture through better infiltration.

There are many benefits to using cover crops as bio-till crops to reduce soil compaction before adopting a no till farming system. See the NRCS MI Agronomy Tech Note 48 Using Cover Crops to Convert to No Till, Agronomy Tech Note 50 Oilseed Radish Cover Crop, and Agronomy Tech Note 51 Radishes: A New Cover Crop Option.

#### **Additional Criteria to Reduce Pest Pressure**

To reduce sugar beet cyst nematode pressure, seed a fall seeding of oil seed radish after small grain. Use only Adagio or Colonel Oilseed radish varieties for this purpose.

Cover crop species shall be selected that have different maturity dates, attract beneficial insects, serve as a trap crop for damaging insects, and/or provide food and cover for wildlife habitat management.

Pacific Gold Oriental Mustard cover crop can reduce damage of herbivore nematodes in orchards and potatoes. See the NRCS MI Agronomy Technical Note 45 Cover Crops for Orchards and NRCS MI Agronomy Technical Note 53, Soil Quality Enhancement for Tree Fruit and Potato Production Using Compost and Pacific Gold Oriental Mustard Cover Crop.

### **Additional Criteria to Encourage Pollination**

Use a mixture or strip planting of different clover species next to field edges and meadows where pollinators are foraging. All of the flowering clovers and alfalfa are good for pollinators. Buckwheat is a good choice for mid to late summer pollen source.

Annually sow Crimson Clover in blueberry alleys to attract bees and provide an additional pollen source. (Mutch, D. 2008. MSUE research trials unpublished data)

### **CONSIDERATIONS**

To establish a good stand, plant cover crops in a timely manner.

When applicable, ensure cover crops are managed and are compatible with the client's crop insurance criteria.

Maintain an actively growing cover crop as late as feasible to maximize plant growth,

allowing time to prepare the field for the next crop and moisture depletion.

When used to redistribute nutrients from deeper in the profile up to the surface layer, consider killing of the cover crop in relation to the planting date of the following crop.

If the objective is to best synchronize the use of cover crop as a green manure to cycle nutrients, factors such as the carbon/nitrogen ratios may be considered to kill early and have a faster mineralization of nutrients to match release of nutrient with uptake by following cash crop.

The right moment to kill the cover crop will depend on the specific rotation, weather, and grower objectives.

Use deep-rooted species to maximize nutrient recovery.

Use grasses to utilize more soil nitrogen, and legumes utilize both nitrogen and phosphorus.

Avoid cover crop species that harbor or carryover potentially damaging diseases or insects.

For most purposes for which cover crops are established, the combined canopy and surface cover is at nearly 90 percent or greater, and the above ground (dry weight) biomass production is at least 4,000 lbs/acre.

Cover crops may be used to improve site conditions for establishment of perennial species.

Use plant species that enhance bio-fuels opportunities.

Use plant species that enhance forage opportunities for pollinators by using diverse legumes and forbs.

Use a diverse mixture of 2 or more species to address multiple purposes.

## **PLANS AND SPECIFICATIONS**

Plans and Specifications will be prepared for the practice site. Plans for the establishment of cover crops shall include:

- Field number and acres
- Species or species of plants to be established
- Seeding rates
- Recommended seeding date
- Establishment procedure
- Planned rate and timing of nutrient application
- Planned dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop.

Plans and specifications for the establishment and management of cover crops may be recorded in narrative form, on job sheets or on other forms.

## **OPERATION, MANAGEMENT, AND MAINTAINENCE**

Control growth of the cover crops to reduce competition from volunteer plants and shading.

Control weeds in cover crops by mowing or by using other pest management techniques.

Control soil moisture depletion by selecting water efficient plant species and terminating the cover crop before excessive transpiration.

Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s)

adjust the management, change the species of cover crop, or choose a different technology

For legume cover mixtures; use the appropriate inoculants or pre-inoculated seed if that particular legume has not been grown on the site within the last 5 years.

Avoid cover crop species that harbor or carryover potentially damaging diseases or insects.

Do not recommend brassicas on the same field for more than two years in a row. Oil seed radish may be susceptible to club root disease or cabbage root maggot and shall not be used in a rotation with vegetable crops susceptible to these pests.

Rye, oats, or barley cover crops are recommended for organic soils.

Oats are recommended where the field will not be tilled in the spring and direct seeding is planned.

## REFERENCES

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45- Cover Crops for Orchards  
46- Buckwheat a Phosphorus Pump  
47- Squeezing More Value from Manure with Cover Crops  
48- Using Cover Crops to Convert to No-till  
49- Cover Crops on the Edge  
50- Oil Seed Radish Cover Crop  
51- Radishes- A New Cover Option  
52- Aerial Seeding of Cover Crops  
53- Soil Quality Enhancement for Tree Fruit and Potato Production Using Compost & Pacific Gold Oriental Mustard Cover Crops  
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- For free copies of MSU bulletins and other references see the pdf files at the following Web sites:

Web2.msue.msu.edu/bulletins/Bulletin/PDF/E-2897.pdf

Web2.msue.msu.edu/bulletins/Bulletin/PDF/E-2896.pdf

[http://www.covercrops.msu.edu/pdffiles/extension\\_bulletin\\_E-2907.pdf](http://www.covercrops.msu.edu/pdffiles/extension_bulletin_E-2907.pdf). (Verified March 31, 2010)

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<http://web2.msue.msu.edu/bulletins/Bulletin/pdf/E-2956.pdf>. (Verified March 31, 2010)

See the following Web site for a list of Aerial Applicators or National Agricultural Aviation Association (NAAA) to aerial seed cover crops:

<http://agaviation.org/>

*Attachment: NRCS Cover Crop Termination Guidelines - Non-Irrigated Cropland*

TABLE 1 - COVER CROP SPECIES

Purpose BD - Bio Diversity EC - Erosion Control EN - Excessive Nutrients NF - Nitrogen Fixation OM - Organic Matter SF - Supplemental Forage SM - Soil Moisture Mgt. WS - Weed or Pest Suppression	Cover Crop Species	Life Cycle	Nitrogen Value (lb/Ac)	Seeding Rate (lb/Ac)	Seeding Depth (inches)	Frost Seed March - mid-April*	Direct Drill or Broadcast and Shallow Till	Overseed Corn @ Vegetative Stage V4 - V8	Overseed Corn by Air or Highboy	Overseed Corn by Air or Highboy	Overseed at Leaf Drop	Seed Post-Harvest	Seed Post-Harvest
							May 1 - mid-June	Early June - early July	Early August - mid-Sept.	Late/mid-Sept. - mid-Oct.	Mid-August - mid-Sept.	Mid-July - Sept. 1.	
<b>B E E N O S S W</b> <b>D C N F M F M S</b>	<b>Legumes</b>												
x	Annual medic	SA	40 - 100	10 - 39	¼ - ½			X			NR		
x	Berseem clover	SA	60 - 90	9 - 20	¼ - ½			X			NR	X	
x	Crimson clover	SA	50 - 60	12 - 20	¼ - ½						X	X	
x	Field peas	SA	30 - 100	70 - 150	1 - 2								
x	Hairy vetch	WA	60 - 180	25 - 40	½ - 2	X		X	X		X	X	9/1-11/1
x	Mammoth red clover	B	60 - 70	8 - 15	¼ - ½			X	X		X	X	
x	Sweetclover	B	70 - 90	8 - 15	¼ - ½			X	X		X	X	
x	Alfalfa	P	50 - 150	9 - 25	¼ - ½								
x	White clover	P	60 - 100	5 - 7	¼ - ½			X	X		X	X	
x	Medium red clover	P	60 - 70	10 - 15	¼ - ½	X		X	X		X	X	
	Alsike clover	B/P	60 - 70	4 - 10	¼ - ½								
	Birdsfoot trefoil	P	40 - 100	5 - 10	¼ - ½								
x	60/40 mix (RC/SC)	B/P	60 - 90	8 - 15	¼ - ½	X		X	X		X		
	Soybeans	SA	0 - 40	1 Bu	1 - 2		X					X	
x	Crownvetch	P	50 - 100	3 - 10	¼		X						
	<b>Non-Legumes</b>												
x	Buckwheat	SA	NA	36 - 60	¼ - ½			X	X		NR	NR	
x	Corn	SA	NA	1 Bu	1½		X						
x	Field Bromegrass	SA	NA	10	¼		X	X					
	Forage turnips	SA	NA	3 - 5	¼ - ½							X	
x	Oats	SA	NA	34 - 68	1 - 2				X		X	X	
x	Oilseed radish	SA	NA	15 - 25	¼ - ½				X		X	X	
	Rape	SA	NA	3 - 8	¼ - ½						X	X	
	Sudan Grass	SA	NA	20 - 25	½ - 1		X					X	
	Annual ryegrass	AW	NA	15 - 25	¼ - ½			X	X			X	
	Barley	AW	NA	48 - 96	1 - 2					X		X	9/10-9/30
x	Cereal Rye	AW	NA	28 - 112	½ - 1					X	X	X	9/1-11/1
x	Triticale	AW	NA	60 - 120	½ - 1					X	X	X	9/10-10/15
x	Wheat	AW	NA	60 - 120	½ - 1					X	X	X	9/13-10/20
	<b>Re Forest Areas</b>												8/1-30 UP
	Redtop		NA	2-6	¼-1/2				x				
	Canada Wildrye		NA	3-6	¼-1	X			x				
	Virginia Wildrye		NA	3-6	¼-1	X			x				
	Riverbank Wildrye		NA	3-6	¼-1	x			x				

Table 2 Cover Crop Seeding Rates Alone and in Seed Mixtures

Crop	Life Cycle	Seeds Per Pound (in thousands)	Seeding Rate Pounds per Acre	Seeding Rate Pounds per Acre	Approximate Days for normal Germination
			Alone	Mixtures	
<b>LEGUMES</b>					
Alfalfa	p	220	12-20	6-10	7
Alsike Clover	b/p	680	6-8	2-4	7
Annual Medic	a	300	10-15		
Berseem Clover	sa	200	9-20	6-10	
Birdsfoot Trefoil	p	375	4-8	3-5	12
Crimson Clover	sa	140	12	6-10	7
Field Peas	a	3	70-150	20-30	
Hairy Vetch	p	20	30-40		10-14
Ladino Clover	p	800	2-6	½-2	7
Red Clover	p	280	10-12	3-8	7
Soybeans	a	5	45-60		
Sweet Clover	b	260	12-15	5-10	7
White Clover	p	800	2-6	1-3	7
60/40 or 80/20 mix	ab	270	10-15	5-10	7
<b>NON-LEGUMES</b>					
Annual Ryegrass	a	227	15-25	4-10	10
Barley	a	14	48-96	36-72	
Buckwheat	a	20	36-60	-	
Cereal Rye	a	18	28-112	44-84	
Field Brome	a	280	15-30	10	
Forage Turnips/Rape	a	157	3-5	1-2	
Oats	a	13	34-68	32-48	
Oilseed Radish	a		15-25	2-5	
Pacific Gold Mustard	a	157	3-5	-	
Sudan Grass	a	55	20-25	-	
Triticale	a	13	60-120	44-84	
Wheat	a	12	60-120	44-84	

Source: Modern Fruit Science Table 1, Pg. 109, MUSE Bulletin 2107 and Northrup King FS 828-1

Note: The purpose of this table is to accommodate custom cover crop seed mixtures and provide guidance of published Seeding rates recommended for seed mixtures. It is suggested to keep an individual seed within the recommended range.

Table 3 Recommended Seed Mixtures (Seed Cocktails)

Seed Mixture	Species	Seeding Rate (lbs/ac)
<b>SM 1</b>	Austrian Winter Pea	20-30
	Oilseed Radish	2-5
<b>SM 2</b>	Hairy Vetch	25-30
	Cereal Rye	56-75
<b>SM 3</b>	Triticale	44-84
	Austrian Winter Peas	40-60