

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
COVER CROP
(acre)
CODE 340**

DEFINITION

Crops including grasses, legumes, forbs, or other herbaceous plants established for seasonal cover and conservation purposes.

PURPOSE

- Reduce erosion from wind and water
- Increase soil organic matter
- Capture and recycle or redistribute excess nutrients in the soil profile
- Promote biological nitrogen fixation & provide nitrogen for the following crop
- Increase biodiversity
- Weed suppression
- Provide supplemental forage
- Soil moisture management
- Reduce particulate emissions into the atmosphere
- Minimize and reduce soil compaction
- Protect growing crops from damage by wind-borne soil particles

CONDITIONS WHERE PRACTICE APPLIES

On all lands requiring vegetative cover for natural resource protection and/or improvement.

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.

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

Cover crops will be terminated by harvest, frost, mowing, tillage, crimping and/or herbicides in preparation for the following crop.

Herbicides used with cover crops will be compatible with the following crop

Avoid using plants that are on the state's noxious weed or invasive species lists.

Cover crop residue will not be burned

Cover crops will be present during the time when protection is needed.

Green Manure Crops

Green manure crops will be incorporated into the soil the spring following seeding, when top growth reaches 12-18". In some cases, annual crops are plowed in the fall of the year seeded. When this occurs, ample protection from wind and water erosion will be provided.

Additional Criteria to Reduce Erosion From Wind and Water

Cover crop establishment, in conjunction with other practices, will be timed 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.

The amount of surface and/or canopy cover needed from the cover crop shall be determined using current erosion prediction technology.

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.

NRCS-Minnesota
September 2007

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the MN Natural Resources Conservation Service in your area, or download it from the electronic Field Office Technical Guide for Minnesota

The NRCS Soil Conditioning Index (SCI) procedure will be used to determine the amount of biomass required to have a positive trend in the soil organic matter subfactor.

The cover crop will be terminated as late as feasible to maximize plant biomass and still prepare the seedbed for the subsequent crop. Cover crops may be sown in the spring or fall for turndown the following spring. Cover crops may also be plowed the year seeded.

Additional Criteria to Capture and Recycle Excess Nutrients in the Soil Profile

Cover crops will be established and actively growing before expected periods of high precipitation that can cause leaching.

Cover crop species will be selected for their ability to take up large amounts of nutrients from the rooting profile of the soil. Use fibrous-rooted cereal grains or grasses to absorb excess nutrients, especially nitrogen.

When used to redistribute nutrients from deeper in the profile up to the surface layer, the cover crop will be killed 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. A late kill may be used if the objectives are to use as a biocontrol and maximize the addition of organic matter. The right moment to kill the cover crop will depend on the specific rotation, weather and objectives.

The aboveground biomass will be removed from the field for maximum nutrient removal efficiency.

Additional Criteria to Promote Biological Nitrogen Fixation

Only legumes or legume-grass mixtures will be established for this purpose.

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

Nitrogen credits from legume cover crops will be accounted for in the nutrient management plan.

Additional Criteria to Increase Biodiversity

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

Additional Criteria for Weed Suppression

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

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

For long-term weed suppression, reseeding annuals and/or biennial species can be used.

Additional Criteria to Provide Supplemental Forage

Species selected will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Forage provided by the cover crop may be hayed or grazed as long as sufficient biomass is left for resource protection.

Additional Criteria for Soil Moisture Management

Terminate growth of the 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 until the subsequent crop is planted.

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

Additional Criteria for use of Cover Crops in Organic Systems

Select the best cover crops by identifying the need and the niche for the crop. Select cover crops that are adapted to the conditions present.

Make a time line of 18-24 months. For each field, write in current or probable rotations showing when crops are typically seeded and when they are harvested. Look for open periods in each field, open spaces on the farm, and ways to extend or overlap cropping windows.

Additional Criteria to Reduce Particulate Emissions into the Atmosphere

Manage cover crops and their residues so that at least 80% ground cover is maintained during planting operations for the following crop.

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.

Additional Criteria to protect growing crops from damage by wind-borne soil particles

Cover crops will be established and growing, or residue will be upright while the crop to be protected is at the most vulnerable stage of growth.

Plants selected for cover crops will have the physical characteristics necessary to provide adequate protection to growing crops from wind and wind-borne soil particles.

The cover crop will be terminated as late as feasible to maximize cover crop growth and protection and still not interfere with growth of the crop being protected.

CONSIDERATIONS

Plant cover crop in a timely manor to establish a good stand.

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.

Deep-rooted species provide maximum nutrient recovery.

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

Mixtures of two or more cover crops are often more effective than planting a single species.

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.

You can increase the range of benefits by increasing the diversity of cover crops grown, frequency of use between cash crops and the length of time they are growing.

More fall growth frequently occurs with the larger seeded grain crops. Under dry soil conditions or when unable to plant until after September 1, it will be advantageous to seed rye or winter wheat.

Use plant species that enhance bio-fuels opportunities.

Use plant species that enhance forage opportunities for pollinators.

PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for each field. Plans for the establishment of cover crops shall include:

- Seedbed preparation
- Recommended seeding dates
- Seed mixture(s)
- Seeding rates
- Establishment procedure
- Planned rates and timing of nutrient application
- Planned dates and method for destroying 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 AND MAINTENANCE

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

Control weeds in the cover crop by mowing or herbicide application.

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

REFERENCES

- Bowman, G., C. Cramer, and C. Shirley. A. Clark (ed.). 1998. Managing cover crops profitably. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 3. National Agriculture Library. Beltsville, MD.
- Hargrove, W.L., ed. Cover crops for clean water. SWCS, 1991.
- Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.
- Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

COVER CROP (340) SPECIFICATIONS

Seedbed Preparation

Prepare a suitable seedbed adequate for the species to be planted and method of planting. This may vary from conventional planting to no till. If seeding the cover crop prior to harvest of the primary crop, no seedbed preparation is needed.

Seeding Method

If seeding the cover crop prior to harvest of the primary crop, it can either be broadcast at the same time or immediately following the last row crop cultivation, or aerial seeded into the growing crop later in the growing season.

If seeding after the harvest of the primary crop, in the fall or prior to the planting of the next crop in the spring, the cover crop may be drilled, broadcast or aerial seeded and incorporated with light, shallow tillage to cover the seed.

Rate & Date of Seeding

To produce maximum growth, fall seeded crops should be planted just as soon as possible after crop harvest. Spring seeded cover crops can be seeded as early as possible depending on the primary crop to be planted. A growth rate of 10 plants per square foot is considered a successful seeding. See Table 1 for seeding rates and dates.

Fertilization

Cover crops usually follow heavily fertilized crops and do not require fertilization. A fall planted fibrous-rooted grass or small grain will scavenge leftover nitrogen from the previous crop. Legumes will add nitrogen to the system for the following crop.

Seed Mixtures for cover crops:

The seeding mixture used will depend on the purpose. Grasses commonly used for cover crops include annual cereals (rye, wheat, barley, oats, buckwheat), annual or perennial forage grasses such as rye grass, and warm season forages like sorghum sudangrass. See Table 2 for performance and roles of crops.

Table 1: Cover Crop - Common Species and Properties

	Erosion Reduction	Increase soil organic matter	Capture, recycle, redistribute nutrients in the soil profile	Promote biological nitrogen fixation	Weed suppression	Provide supplemental hay	Provide supplemental grazing	Rooting Depth / Plant Water Use /1	Minimize / reduce soil compaction	Seed size (Large or Fine)	Crop Type /2	Seeding rate, lbs/acre	Seeding depth, inches	Salinity tolerance	C:N Ratio	Attract Beneficial Insects	Mycorrhizal fungi association
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
barley	G	G	F	N	G	F	F	MM	F	L	CG	50	0.75 - 2.0	G	M	Y	L
berseem clover	P	P	F	Y	F	F	G	MH	F	F	CB	8	0.25 - 1.0	F	L	Y	L
buckwheat	G	F	G	N	G	P	P	SL	P	F	WB	48	0.5 - 1.5	P	L	Y	N/A
canola	F	F	G	N	P-G**	F	F	MM	G	F	CB	5	0.25 - 0.75	G	L	Y	N/A
corn	G	G	G	N	P-G**	F	F	DH	G	L	WG	20	1.0 - 1.5	P	H	N/A	H
cowpea	P	P	F	Y	G	F	F	SL	F	L	WB	30	1.0 - 1.5	P	L	Y	M
flax	F	F	F	N	P	P	P	SM	P	F	CB	50	0.25 - 0.75	P	H	N/A	H
hairy vetch	G	F	F	Y	P	F	F	SM	F	L	WB	15	0.5 - 1.5	P	L	Y	M
lentil	P	P	F	Y	P	F	F	SL	P	F	CB	80	1.0 - 1.5	P	L	N/A	M
medic	P	P	G	Y	F	F	F	MM	F	F	CB	8	0.25 - 0.75	P	L	N/A	M
millet	G	G	F	N	G	G	F	SL	F	L	WG	25	0.25 - 0.75	F	M	N/A	H
mustard, tame	F	F	F	N	G	F	F	MH	F	F	CB	5	0.25 - 0.75	P	L	Y	N/A
oat	G	G	F	N	F	G	F	MM	F	L	CG	80	0.5 - 1.5	P	M	N	L
pea	P	P	P	Y	F	G	F	SL	P	L	CB	50	1.5 - 3.0	P	L	Y	M
radish	P	P	G	N	G	P	G	DH	G	F	CB	8	0.25 - 0.5	P	L	Y	N/A
Red beet	P	P	G	N	F	P	F	DM	G	L	CB	8	0.5 - 0.75	F	L	N	L
safflower	F	F	G	N	F	F	G	DH	F	L	WB	30	1.0 - 1.5	F	M	N	H
sorghum	G	G	G	N	G	G	F	MM	G	L	WG	35	0.5 - 1.5	P	M	Y	H
soybean	P	P	F	Y	P-G**	F	F	SM	P	L	WB	45	1.0 - 1.5	P	L	N/A	M
spring rye or wheat	G	G	G	N	G	F	F	MH	F	L	CG	60	0.5 - 1.5	F-G	M	Y	L
sudangrass, sudan-sorghum hybrid	G	G	G	N	G	G	G	MM	G	L	WG	35	0.5 - 1.5	F-G	M	Y	H
sugarbeet	P	P	G	N	F	P	G	DH	G	F	CB	8	0.25 - 0.5	G	L	N/A	L
sunflower	F	F	G	N	F	P	G	DM	F	L	WB	4	0.5 - 1.0	F	M	N/A	H
sweet clover	G	F	F	Y	F	P	F	MM	F	F	CB	6	0.25 - 1.0	F	L	Y	M
triticale	G	G	G	N	G	F	F	MH	F	L	CG	60	0.5 - 1.5	G	M	Y	L
turnip	P	P	G	N	G	P	G	DH	G	F	CB	8	0.25 - 0.5	P-F	L	N/A	N/A
winter rye or wheat	G	G	G	N	G	F	F	MH	F	L	CG	60	0.75 - 2.0	P	M	Y	L

/1 Rooting Depth/Water Use	
SL= Shallow rooted/Low water use	Shallow - 6 - 18 inches
SM= Shallow rooted/Medium water use	Medium - 18 - 24 inches
SH= Shallow rooted/High water use	Deep - 24 + inches
ML= Medium rooted/Low water use	
MM= Medium rooted/Medium water use	
MH= Medium rooted/High water use	
DL= Deep rooted/Low water use	
DM= Deep rooted/Medium water use	
DH= Deep rooted/High water use	

/2 Crop types	
CG = cool season grass	
CB = cool season broadleaf	
WB = warm season broadleaf	
WG = warm season grass	

Ratings	
L = Low	G = Good
M = Medium	F = Fair
H = High	P = Poor
N/A = Not Available	

**Poor weed competitor, but herbicide-tolerant varieties are available.

Table 1 was compiled from several sources listed in the Cover Crop Design and Installation Guide reference section and field observations.

TABLE 2 – COMMON COVER CROPS

Species	Seeding Rate	Seeding Depth (inches)	Seeding Date	Comments
Non-Legumes: fall seeding				
Annual Ryegrass	15 – 20 lbs. / ac.	¼ to ½	June 1-July 1 or Aug. 15 – Sept. 15	Easily established. Good for use as overseeding row crop. May be seeded after harvest.
Barley	1.5 – 2 bu. / ac.	½ to 1 ½	Aug. 15 to Sept. 15	May be overseeded into growing crop or seeded after harvest.
Oats	1 – 2 bu./ ac.	½ to 1 ½	Aug. 15 to Sept. 15.	Can be seeded on rough plowed land (usually before Sept. 1) and will not need plowing the following spring
Cereal Rye	1 – 1 ¼ bu./ ac.	½ to 1 ½	Aug. 15 to Sept. 15	Easily established. Rapid growth in fall and spring. Has allelopathic properties.
Winter Wheat	1- 1 ½ bu. / ac.	½ to 1 ½	Aug. 15 – Sept. 15	Advantageous if site is seeded after Sept. 1 or under dry soil conditions.
Buckwheat	35 – 60 lbs. / ac.	½ to 1 ½	June 1 to July 10.	Summer smother crop. Residue degrades rapidly.
Sorghum – Sudan	25 – 30 lbs. / ac.	½ to 1	May 15 to July 1.	Advantageous to use on well drained and droughty sites.
Non-Legumes: spring seeding				
Barley	0.75 bu./ac	½ to 1 ½	April 1 to May 15	May be broadcast or drilled; kill by using chemicals or row cultivation or both
Spring Wheat	0.75 bu./ac	½ to 1 ½	April 1 to May 15	May be broadcast or drilled; kill by using chemicals or row cultivation or both
Legumes:				
Berseem Clover	10 – 15 lbs./ ac.	¼ to ½	Early spring in small grain.	Summer annual. Often mixed with ryegrass or small grains. Heavy N producer, establishes well with an oat

				nurse crop – excellent cover for sg-c-sb rotations. Winter kills.
Cowpeas	30 – 90 lb/Ac	1 to 2	May 15 to July 1.	Summer annual adapted to southern MN. Often mixed with sorghum-sudangrass or interseeded with corn.
Crimson Clover	10 – 15 lbs./ac.	¼ to ½	Early spring in small grain or Aug. 1 – Sept. 15	Adapted to southern MN; rapid summer or fall growth; use as a winter killed annual like oats. Provides good groundcover and weed control.
Hairy Vetch	20 – 30 lbs. / ac	½ to 1 ½	Aug. 1 to Sept. 15	Adapted to southern MN; produces plenty of residues to condition soil and supply N. It can provide sufficient N for many vegetable and late planted crops and partially replace N for corn. Smothers spring weeds. Commonly planted with winter cereals.
Medics	10 – 20 lbs. / ac	¼ to ½	Aug. 1 – Sept. 15	Adapted to all of MN; ideal for long rotations of forages and cash crops. Often used after wheat harvest. May become invasive if allowed to seed out. Hard seed will remain viable in soil for many years.

Medium Red Clover	8 – 10 lbs. / ac.	¼ to ½	April 15 to June 15 or Aug. 1 to Sept. 15.	Good on somewhat poorly drained sites and potato fields with moderate pH. Prefers drilling to broadcast.
Sweet Clover	8 – 10 lbs. / ac.	¼ to ½	Early spring in small grain or Aug. 1 to Sept. 15	Advantageous to use on well drained and droughty sites. Prefers drilling to broadcast. May become invasive if allowed to seed out. Hard seed will remain viable in soil for many years.
White Clover	5 – 7 lbs. / ac.	¼ to ½	Aug. 1 to Sept. 15	Often mixed with annual rye or red clover. Good when planted between rows of irrigated vegetables or trees.

TABLE 3 PERFORMANCE AND ROLES

Species	N-Source	Soil Builder	Erosion Fighter	Subsoil Loosener	Weed Fighter	Pest Fighter	N-Scavenger	Good Grazing	Quick Growth	Lasting Residue
Annual Ryegrass		X	X		X		X	X	X	X
Barley		X	X		X		X	X	X	X
Oats			X		X		X		X	
Rye		X	X		X	X	X		X	X
Winter Wheat			X		X		X	X		X
Buckwheat					X				X	
Sorghum Sudan		X	X	X	X	X	X	X	X	X
Berseem Clover	X	X	X		X		X	X	X	
Cowpeas	X		X		X				X	
Crimson Clover	X	X	X		X			X		
Hairy Vetch	X	X	X							
Medics									X	
Red Clover	X	X						X		
Sweet Clover	X	X	X	X				X		X
White Clover	X		X					X		