

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

COVER CROP

(Ac.)

CODE 340

DEFINITION

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

all Federal, state, and local laws) and site conditions.

The species selected will be compatible with other components of the cropping system, including the nutrient management and pest management provisions of the conservation plan.

PURPOSE

- 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.
- Increase biodiversity.
- Weed suppression.
- Provide supplemental forage.
- Soil moisture management.
- Reduce particulate emissions into the atmosphere.
- Minimize and reduce soil compaction.

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

Cover crop residue will not be burned.

Application of this practice, including seedbed preparation, should be done in accordance with FOTG: Sec. IV: 550DP: Herbaceous Vegetation Design Procedures.

Refer to Table 1 and 2 for selecting an appropriate cover crop to meet the planned use, and detailed information for seeding rates and dates.

CONDITIONS WHERE PRACTICE APPLIES

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

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 to control erosion to within the soil loss tolerance (T) or other planned soil loss objectives.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with approved local criteria (including

Plants selected for cover crops will have the physical characteristics necessary to provide adequate protection.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

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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.

The NRCS Soil Conditioning Index (SCI) procedure will be used to determine the amount of biomass, type of cover crop, type of cropping system, tillage system and other management practices required to have a positive trend in the soil organic matter subfactor. Refer to other appropriate practice standards such as 329 Residue Management No-Till/Strip Till for requirements of other practices.

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

Refer to Table 1 and 2 for guidance on selecting the appropriate cover crop, and seeding dates and rates.

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

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

Cover crop species will be selected for their ability to take up large amounts of nutrients from the rooting profile of the soil. Winter annual cover crops such as rye or wheat will be utilized after harvest of spring planted crops for this purpose. Refer to Table 1 and 2 to determine the most appropriate cover crops to tie-up and recycle nutrients and seeding rates and dates. Refer to Chapter 6 of the National Engineering Handbook, Ag Waste Management Field Handbook to determine the amount of nutrients tied-up/utilized by various cover crops.

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 chemical 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.

If excess nutrients in the soil profile are more than the cover crop can tie-up, the cover crop will be harvested in order to remove the maximum of amount of excess nutrients.

Additional Criteria to Promote Biological Nitrogen Fixation

Only legumes or legume-grass mixtures will be established as cover crops.

The specific Rhizobium bacteria for the selected legume will either be present in the soil or the seed will be inoculated at the time of planting. Refer to Table 1 and 2 for selecting appropriate legumes and seeding dates and rates.

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. The tillage and cropping system must have a positive SCI using RUSLEII. Diverse cropping systems in conjunction with cover crops and no-till are ideal for achieving maximum bio-diversity on cropland.

The type of cover crops shall be different than the previous crop and next crop to be planted (i.e. Cool season grass will not follow cool season grasses). For a complete list of cover crop types refer to Table 1. Refer to Table 2 for additional guidance on selecting the appropriate cover crop and tillage system to maximize biological diversity.

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 such as rye will be allowed to grow to maturity and residues will be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

For long-term weed suppression, reseeding annuals cover crops such as rye, and/or biennial species that can reseed such as Sweet clover can be used. Cover crops with allelopathic effects are listed in Table 1

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. Species such as oats, triticale, rye, turnips, rape, millet, or forage sorghum can be planted after early harvested crops such as wheat, soybeans, or corn silage to provide supplemental forage. Cover crops can be aerially applied prior to crop harvest when necessary.

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

Refer to Table 1 and 2 for selecting an appropriate cover crop to provide supplemental forage and for seeding rates and dates. Additional information on selecting cover crops is also found in the considerations section of this standard.

Additional Criteria for Soil Moisture Management

When lack of soil moisture is a concern 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.

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 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.

Wind erosion must be controlled to soil loss tolerance T or less if targets are set for the area. The current wind erosion prediction technology in Section I of the FOTG will be used.

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. Refer to Table 1 and 2 for selecting an appropriate cover crop to reduce soil compaction and for seeding rates and dates.

CONSIDERATIONS

Cover crops may be used for various purposes and conditions. Refer to Table 1 and Table 2 for the various uses and recommendations.

Considering cover crops is especially beneficial after harvesting early crops such as soybeans, corn silage. Especially the soil will have little residue cover, exposing it to wind and water erosion.

Hairy vetch is an excellent legume cover crop in no-till cropping systems that will produce nitrogen for next year's crop.

For fall forage, oats is a good choice because it has the greatest forage yield potential of small grains planted in the fall. Another advantage of oats is that it will die over winter and not interfere with next year's crop. Oat residue, however, is not very durable and provides less effective soil protection for a shorter time. Turnips can also be a good choice for fall forage in field with high residue levels and can be planted with oats.

Rye provides the best soil protection, among the small grains. Rye also provides abundant early

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spring growth that can be used for forage. Fall growth is a little better than wheat or triticale, but not as good as oats. It also provides allelopathic effects for weed suppression if it is allowed to mature.

To maximize late spring forage yield and quality, especially as hay or silage, triticale is best. While more expensive to plant and less winter hardy than rye, it can't be beat for late spring forage.

Winter wheat is a good choice by providing a dual option of grain production and/or winter soil protection.

During wet years, fall planted cover crops in cropping systems can provide additional benefits, by drying the surface soil allowing for earlier spring planting.

Plant cover crops in a timely matter according to dates listed on Table 1 in order to increase establishment success.

To maximize erosion control, biomass and other soil quality parameters, maintain an actively growing cover crop as late as feasible to maximize plant growth. Use deep-rooted species such as rye for winter annual or sorghums for summer annuals to maximize nutrient recovery.

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

Avoid using the same cover crop species year after year. This can lead to more diseases or insect problems.

For most purposes for which cover crops are established, the combined canopy and surface cover is at nearly 60 percent or greater, and the above ground (dry weight) biomass production is at least 2700 lbs/acre.

Summer annual cover crops may be used to improve site conditions for grass establishment.

Flowering species such as legumes are ideal for pollinators.

PLANS AND SPECIFICATIONS

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

- Species or species of plants to be established.
- Purpose of cover crop (refer to Table 2)
- Type of planting/tillage system to be used (e.g. no-till drill)
- Seeding rates.
- Recommended seeding dates.
- Establishment procedure.
- Planned rate, timing and type/form of nutrient application.
- Planned dates for killing cover crop (if applicable).
- 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 designed to provide specific requirements for the practice.

Fertilization

- The recommended rate of fertilizer for plants used should be based on soil test results and the Nutrient Management Standard 590
- In cases where time is lacking to make a soil test, a general recommendation is 20 lbs of Nitrogen in Vegetative Zones I and II and 40 lbs Nitrogen in Vegetative Zones III and IV for small grain cover crops.
- When establishing legume cover crops, special consideration shall be given to pH and Phosphorous levels. Recommendations on liming and P fertilizer application will be based on soil tests and Nutrient Management Standard 590.

OPERATION AND MAINTENANCE

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

Ensure that cover crops do not become invasive and that cover crops are compatible with planned crops/vegetation.

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

Manage soil moisture depletion by selecting species that use little soil moisture, and by killing the cover crop before excessive transpiration occurs.

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.

National Engineering Handbook, Agricultural Waste Management Field Handbook, USDA-Natural Resource Conservation Service, April 1992.

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Table 1. Type of cover, rate of planting, when to plant and Vegetative Zones for adaptation.

Vegetative Zones	1/ Cover Crop Type	Rate of Seeding 2/	3/ Time of Planting	4/ Type	5/ Winter Hardy
All	Alfalfa	8-12 lbs/ac	4/1-5/15 or 8/15-9/15	P (L)	Yes
All	Barley	1-2 bu/ac	3/15-5/15 or 8/01-9/15 (cover crop or forage only)	CSA (SG)	Spring barley: No Winter barley to -20° F
All	Buckwheat	40-50 lbs/ac	07/1-08/1	SA/CSA (SG)	No
I, II	Chickpea	95-100 lbs/ac	04/15-05/15	SA (L)	No
III, IV	Corn	1-2 bu/ac	05/15-08/15	SA	No
I, II	Field Pea	80-100 lbs/ac	03/15-04/15	SA (L)	No
All	Flax	30-40 lbs/ac	04/20-05/10	CSA	No
All	Foxtail Millet	15-25 lbs/ac	05/15-08/15	SA	No
III, IV	Ladino (white) Clover	2-3 lbs/ac	08/15-09/15	P (L)	to -10° F
I, II	Mustard (brown)	3-6 lbs/ac	03/15-04/1	CSA	No
All	Oats	2-3 Bushels (1/2-1 bushel when used as a companion crop with cool season grass plantings)	3/15-5/15 or 8/01-9/15 (cover crop or forage only)	CSA (SG)	No (tolerates slightly below 32° F)
II, III, IV	Oats and Vetch	30-50 lbs/ac 15-20 lbs/ac	03/15-05/15 or 8/01-9/15	Refer to the individual crops	
All	Pearl Millet	10-15 lbs/ac	05/15-08/15	CSA	No
All	Proso Millet	8-16 lbs/ac	05/15-08/15	CSA/SA	No
I, II	Rapeseed/Canola	4-6 lbs/ac	3/15-4/15 or 8/22-9/12	WA/CSA	to -20° F
III, IV	Red Clover	6-8 lbs/ac	08/15-09/15 or 3/15-05/15	P (L)	to -20° F
I, II	Rye	1-2 bu/ac	08/01-09/15 or 03/15-05/15	CSA (SG)	Yes (-30° F)
III, IV	Rye	1-2 bu/ac	08/01-10/15 or 03/15-05/15	CSA (SG)	Yes (-30° F)
II, III, IV	Rye and Vetch	50-60 lbs/ac 15-20 lbs/ac	08/01-09/15 or 03/15-05/15	Refer to the individual crops	
All	Ryegrass (annual)	20-25 lbs/ac	3/15-5/15 or 8/01-9/15	CSA	to 0° F
All	Ryegrass (Italian)	20-25 lbs/ac	3/15-5/15 or 8/01-9/15	CSA 6/	to 0° F
All	Safflower	20-25 lbs/ac	04/20-05/10	CSA	No
All	Sorghum or Forage Sorghum	10-15 lbs/ac	05/15-08/15	SA	No
All	Sorghum Sudan	15-25 lbs/ac	05/15-08/15	SA	No

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III, IV	Soybeans	1 bu/ac	6/1-7/15	SA	No
III, IV	Strawberry Clover	6-8 lbs/ac	08/15-09/15 or 03/15-05/15	P (L)	to -20° F
All	Sudangrass	15-25 lbs/ac	05/15-08/15	SA	No
All	Sweet Clover	8-10 lbs/ac	08/01-09/15 or 11/01-05/15	B (L)	to -20° F
I, II	Triticale	1-2 bu/ac	8/01-9/15	WA (SG)	to -20° F
III, IV	Triticale	1-2 bu/ac	8/01-10/15	WA (SG)	to -20° F
I, II	Turnips	2-6 lbs/ac	7/15-9/1 (can be planted as early as March, but best planted in late summer following wheat harvest for double cropping, early harvested crops, or aerially applied prior to crop harvest).	CSB	to -20° F Provides growth down to 15° F (turns dormant below this temp)
III, IV	Turnips	2-6 lbs/ac	7/1-9/1 (can be planted as early as March, but best planted in late summer following wheat harvest for double cropping, early harvested crops, or aerially applied prior to crop harvest).	CSB	to -20° F Provides growth down to 15° F (turns dormant below this temp)
II, III, IV	Vetch (Hairy or Crown)	15-20 lbs/ac	08/01-09/15 or 11/01-05/15	WA (L)	to -20° F
I, II	Wheat	1-2 bu/ac	08/15-09/15 or 03/15-05/15	WA (SG)	to -20° F
III, IV	Wheat	1-2 bu/ac	08/15-10/15 or 3/15-05/15	WA (SG)	to -20° F

1/ Hairy and crown vetch can become invasive in some areas. Rye cover crops should be avoided in areas where wheat is grown. Cover crop selected must be adapted to the soil and site conditions.

2/ Rate of seeding is dependent upon the purpose of the planting and available soil moisture, or if the site is irrigated. If seed is broadcasted/aerial applied the highest rate of seeding should be used. Other practice specifications may apply (i.e. 645 Wildlife Food Plot) and should be consulted for seeding rate guidance.

3/ Later planting dates should be avoided when soil moisture is lacking and/or select cover crops that are the most conducive to drought conditions.

4/ Type: B=biennial; CSB=cool season biannual; CSA=cool season annual; SA=summer annual; P=perennial; WA=winter annual; (L)=legume; (SG)=Small Grain/Cereal

5/ Winter hardiness will vary by variety.

6/There is a great difference in varieties of Italian Ryegrass, some will not survive the winter and others may last for several years and may have to be killed with a burndown herbicide,

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Table 2. Management and Use of Cover Crops

Use of Cover	Cover Type	1/ Management of Cover Crop for Designated Use
Biodiversity	All appropriate types	Select cover type based on the management objective: increase plant diversity, to attract beneficial insects, trap damaging insects, provide food and cover for wildlife. Cover crop types include warm season/cool season grass cover crops and warm season/cool season broadleaf cover crops. Select a cover crop with a varying growth cycles to maximize bio-diversity benefits. Carbon is the largest element used by plants and managing carbon through crop rotations and cover crops provides, both diversity and intensity, and along with no till will have the greatest impact on crop production and soil health.
Companion Cover Crop	Oats or other spring small grains	Plant at the same time as cool season grasses or legume seedings. Avoid planting high rates or allowing oats to mature as it will compete too much with grass/legume seeding.
Forage	Oats, Triticale and all small grains, Pearl Millet, Rye, Forage Sorghum, Sorghum-Sudan, Sudangrass, Triticale, Wheat, Oats, Rape, Turnips	Select species based on supplemental feed needs and palatability. Haying and grazing will be managed to provide/retain adequate cover for resource protection. <i>For fall forage, oats is a good choice because it has the greatest forage yield potential of small grains planted in the fall. Turnips can also be a good choice for fall forage in field with high residue levels and can be planted with oats. To maximize late spring forage yield and quality, especially as hay or silage, triticale is best. For summer forage sorghum sudan or other warm season grasses with high yield potential are best.</i>
Ground Cover for Erosion Control	All Types, depending on the amount of biomass, and timing of growth needed	Whenever temporary cover crops are needed for erosion control or weed control (construction sites, vineyards, orchards, windbreaks, etc.) Cover crops should be reseeded annually as needed. Select cover crop that best fits the timing and amount of cover needed. For example, oats can be used for spring seedings; wheat, rye or annual ryegrass for fall seedings.
Native Grass Planting	Corn, Sorghum, Sorghum-Sudan Cross, Millet, Sudan, Forage Sorghum, Late Planted Oats	Plant cover crop in July through Mid-August to achieve 12-18 inches of growth prior to killing frost, otherwise plant earlier and plan to harvest and allow for 12-18 inches of re-growth prior to a killing frost. Manage cover crops so they do not over-grow or go to seed. Remove excess growth if necessary. Refer to Herbaceous Vegetation Design Procedures (550DP)
Nitrogen Fixation Cover Crops	All appropriate legume cover crops listed in Table 1	Plant early enough to ensure adequate growth and fixation prior to planting the crop that will utilize the fixed Nitrogen (i.e. Corn, Sorghum, Small Grains, etc.)
No-till cover crops	All appropriate types based on the crop to be no-tilled	Plant directly into dead residue. Be aware of allelopathic effects 2/. Select cover crops with based on growth cycle, erosion control, ability to kill cover crop with burn down herbicides and amount of biomass desired. The goal for cover crops is to increase biological diversity and to keep live growing crops in place as much of the year as possible as well as providing cover. <i>Hairy vetch is an excellent legume cover crop in no-till cropping systems that will produce nitrogen for next year's crop.</i>
Nutrient Utilization/ tie-up of excess nutrients	All appropriate types	Select cover crops based on the time of year that nutrient tie-up/uptake is desired and those that maximize nutrient uptake (i.e. Forage Sorghum or Sudan cut for forage during the summer). Refer to the National Engineering Handbook, Ag Waste Management Field Handbook, Chapter 6 for the amount of nutrients tied up or used. Use Rye, Wheat or Rye/Vetch for fall seeding immediately following harvest of spring seeded crops.

Soil Organic Matter Content	All Types	Utilize the Soil Conditioning Index (RUSLE2) to determine to determine the amount of biomass and type of cover required to result in a positive value. Plant as early as possible (Table 1) and terminate as late as possible except where soil moisture depletion is a concern. Cover crops with the highest amount of biomass (root and above ground) will improve organic matter the fastest.
Soil Compaction	Sudangrass, Sweet clover, Sorghums	Select species that will produce deep tap roots and large amounts of root biomass.
Weed suppression (allelopathic)	Rye (best),and other small grains, Sweetclover (best) and other legumes (refer to table 1)	For maximum benefits allow Rye (other small grains) to reseed itself over several years. Rye and other small grains must be allowed to go to maturity and residue must be retained.
Wind or Water Erosion Control	Rye, Rye/Vetch, Oats, Wheat, Triticale, Annual Ryegrass, Italian Ryegrass, Summer annual cover crops should be used when cover is needed during the summer months.	Plant as early as possible in the fall to maximize growth and residue production needed. Burn back growth with chemical or undercut after April 15th or later to maximize growth before planting. A minimum of 12 inches of growth is optimal to achieve best results for erosion control. Refer to Nebraska Agronomy Technical Note No. 109.

1/ When using and applying Herbicides, follow label directions. The use must be consistent with the uses listed on the label. Consider the possibility of herbicide carryover that might affect the establishment of any type of cover crop planting.

2/ The most commonly known allelopathic crops are rye and sweetclover, but oats, barley, wheat, red clover, white clover, Berseem clover, alsike clover, hairy vetch, buckwheat, mustard species, canola, creeping red fescue, tall fescue, sunflowers and perennial ryegrass also have allelopathic properties to varying degrees. These crops may not be suitable to use as cover for establishing herbaceous vegetation (grass or forb seedings).