NATURAL RESOURCES CONSERVATION SERVICE

NEW JERSEY

CONSERVATION PRACTICE STANDARD

COVER CROP

(acre)

CODE 340

DEFINITION

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

PURPOSES

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

CONDITIONS WHERE PRACTICE APPLIES

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 recommended cover crops, approved seeding rates, and optimum time of planting and killing are listed in Table 1. Additional cover crop species and mixtures may be acceptable with prior approval from the State Resource Conservationist.

Winter annual grasses and legumes shall be sown just prior to or immediately after harvest of the primary crop.

Overseeding is an acceptable establishment method. Winter rye, annual ryegrass, hairy vetch and various clovers can be overseeded into row crops before harvesting. Overseeding allows the cover crop to get a head start and provides soil coverage when the primary crop is harvested. It also reduces goose damage to young seedlings.

The species selected will be compatible with the nutrient management and pest management provisions of the plan.

Cover crops will be terminated by frost, mowing, tillage, and/or herbicides in preparation for the following crop. One exception is that some perennial legumes, such as crownvetch and flatpea, can be successfully managed as a permanent, living mulch on cropland. Best results are obtained if the seed is covered by drilling or cultivating lightly after broadcasting.

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

Cover crop residue will not be burned.

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). Seeding cover crops as early as possible will result in satisfactory cover. For all seedings, plant the cover crop within the time period indicated on Table 1. This may be immediately after harvesting the previous crop, or in the case of a late harvest, it may require overseeding. For fall seedings, it is vital that the seeding be no later than the seeding period so that sufficient growth occurs before winter dormant season. For spring or summer seedings, it is vital that the seeding be no later than the seeding period so that sufficient growth occurs before the summer drought or dormant season. In areas of large goose populations, adequate control over grazing is crucial to adequate cover.

When later seedings are needed, select a cover crop that will germinate rapidly to help assure a successful stand. Annuals generally germinate more rapidly than perennials, and grasses generally germinate more rapidly than legumes. To perform satisfactorily, cover crops must provide at least 70% soil surface coverage during the critical erosion or water runoff period.

For best results, seeds should be placed at a controlled depth with the soil firmed around the seed. This will give good seed to soil contact, necessary for providing sufficient moisture for seed germination and growth. Drilling seed provides the best seeding method and uniform soil coverage. See Table 1 for seeding methods.

For orchards, vineyards, and nurseries where permanent vegetative covers are intended to establish cover 1 to 2 years before planting the orchard or vineyard, and strip-kill the cover with herbicides or cultivation prior to planting.

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 required to have a positive trend in the soil organic matter subfactor.

The cover crop shall be planted plant 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 the 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 field for planting the next crop and soil moisture depletion.

Additional Criteria to Promote Biological Nitrogen Fixation and Reduce Energy Use

Use legumes or legume-grass mixtures to establish 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.

Select a winter annual legume or legume/grass mixture as indicated on Table 1. Winter annual legumes can provide a nitrogen source for a succeeding summer crop.

To perform satisfactorily, cover crops must provide at least 80% soil surface coverage by the spring to provide uniform amounts of nitrogen. Uniform soil coverage is generally a function of method of seeding. See Table 1 for seeding rates and planting dates.

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, attract pollinators, 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 competition 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, perennials and/or biennial species can be used (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.

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. This is usually two weeks prior to planting the intended 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 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. These covers should increase soil organic matter, improve soil structure, and increase deep soil moisture through better surface infiltration.

CONSIDERATIONS

The cover crop should be terminated as late as feasible to maximize plant growth and still prepare the seedbed for the subsequent crop.

Deep-rooted species provide maximum nutrient recovery.

Consider that grasses utilize more soil nitrogen, and legumes utilize both nitrogen and phosphorus.

Avoid cover crop species that attract potentially damaging insects.

Acceptable benefits, for most purposes, are usually accomplished when the plant density is at least 25 stems per feet, the combined canopy and surface cover is at least 60 percent, and the above ground (dry weight) biomass production is at least 2700 lb/acre.

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

PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for the practice site. Specifications will include, but are not limited to, recommended species, seeding rates and dates, establishment methods, nutrients needed, and other establishment or management information. Specifications can be recorded in narrative format, on job sheets, or forms designed to provide specific requirements for the practice.

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.

REFERENCES

A. Clark (ed.). 2007. Managing Cover Crops Profitably. 3rd ed. Sustainable Agriculture Network Handbook Series; book 9.

Hargrove, W.L., ed. Cover Crops for Clean Water. SWCS, 1991.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; book 4. National Agriculture Library. Beltsville, MD.

Penn State Cooperative Extension, Cover Crop Field Day 2011.

Reeves, D.W. 1994. Cover Crops and Erosion. p. 125-172 J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

TABLE 1. Species	Life Cycle [1]	Plant Hard. Zone	Seeding Rate [2] (lb/A)	Seeding Date	Killing Period	N-fixation (lb/A)	Advantages	Disadvantages
LEGUMES								
Hairy vetch (Viscia villosa Roth)	WA	All	20-40	Aug/early Sept	No later than 2 weeks prior to planting of next crop	80-250	Most cold tolerant and highest yielding of all winter annual legumes; above-average drought tolerance; adapted to wide range of soil types	Requires early fall establishment, and slow to establish; little winter cover possible; matures in late spring; high P and K requirement for maximum growth; can harbor pests; potential weed problem in winter grains
Crimson clover (Trifolium incarnatum L.)	WA/SA	All	9-40 (avg 18-20)	Aug	No later than 2 weeks prior to planting of next crop	70-130	Rapid growth; above- average shade tolerance; forage use (no bloat); good nematode resistance	Poor heat and drought tolerance; no-till planting in residue is difficult due to steminess
Red clover (Trifolium pratense)	SLP (2-3 all yr)	All	7-18	Aug	No later than 2 weeks prior to planting of next crop	100-110	Thick, deep taproot; adapted to humid areas; tolerates wet soil conditions and shade; forage use only if mixed with grasses	Initial growth slow; high P and K requirements for maximum growth; seed can persist creating volunteer problems; pure stand forage causes bloat.

[1] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial;

[2] Higher rates may be necessary for broadcast seedlings

LEGUMES	Life Cycle [3]	Plant Hard. Zone	Seeding Rate [4] (lb/A)	Seeding Date	Killing Period	N-fixation (lb/A)	Advantages	Disadvantages
White clover (Trifolium repens L.)	LLP	All	6-14	Aug or spring	Terminate and reestablish as needed to meet primary conservation purpose	100-130	Adapted to most temperate zones; good heat, flood, drought, shade tolerance; low-maintenance and tolerates high traffic; forage use with grasses (better yields)	As a living mulch, may become competitive with crop if not mowed or tilled under; no yield during hot-dry weather; good nutrient management necessary; susceptible to some diseases, insects
Field peas (Pisum spp.) (e.g., Austrian winter pea)	SA/WA	6b&7	70-220	Aug or spring	No later than 2 weeks prior to planting of next crop	50-150	Rapid growth in cool weather; versatile legume; interseed with cereal and brassica spp.; used as food or feed	Austrian winter pea will not overwinter north of MD; shallow root system; sensitive to heat and humidity; susceptible to diseases, insect pests
Crownvetch (Coronilla varia L.)	LLP	All	5-20	Spring or early summer	Suppress prior to planting crop	40 (suppressed)	Deep rooted and long- lived; good tolerance to heat, drought, and cold; no known insect or disease problems; excellent erosion control; fixes own nitrogen; can be managed as living mulch	Slow germination and establishment; high degree of management necessary; competes with crop if not suppressed

[3] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial;

[4] Higher rates may be necessary for broadcast seedlings

Birdsfoot trefoil (Lotus comiculatus L.)	SLP	5b&6a	5-10	Spring or early summer	Suppress prior to planting crop	40	Quick establishment; tolerates poorly drained soils and low pH; fixes own nitrogen; can be managed as living mulch	Competes with crop if not suppressed or killed; does not spread and fill in on its own

GRASSES	**Life Cycle [5]**	**Plant Hard. Zone**	**Seeding Rate [6] (lb/A)**	**Seeding Date**	**Killing Period**	**Value for Nutrient Mgt.**	**Advantages**	**Disadvantages**
Barley (Hordeum vulgare)	WA	All	100	North of Rt. 1[7] by 10/15; south by 11/1	No later than 2 weeks prior to planting of next crop	Fair nutrient scavenger	Will perform about the same as oats. Biomass easy to manage in spring	Early cold may prevent growth to sufficient cover; regrowth may occur
Cereal rye (Secale cereale L.)	WA	All	60-200	North of Rt. 1 by 10/15; south by 11/1	No later than 2 weeks prior to planting of next crop	Excellent nutrient and moisture scavenger (esp. N)	Most cold tolerant of commonly used cover crops, late seedlings possible, germinates and grows rapidly; tolerates poor soil conditions and drought; rapid growth may provide some weed control; various uses: cover crop to food source	Regrowth may occur if not completely controlled (mature rye difficult to manage); possible crop suppression due to allelopathy or nutrient tie-up by rye; pest problems: small grain insects, diseases

[5] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial;
[6] Higher rates may be necessary for broadcast seedlings
[7] Rt. 1 refers to U.S. Route 1, which generally divides New Jersey between the Piedmont and Coastal Plain.

GRASSES	Life Cycle [8]	Plant Hard. Zone	Seeding Rate [9] (lb/A)	Seeding Date	Killing Period	Value for Nutrient Mgt.	Advantages	Disadvantages
Winter Wheat (Triticum vulgare)	WA	All	120	North of Rt. 1 by 10/15; south: 11/1	No later than 2 weeks prior to planting of next crop	Fair nutrient scavenger	Biomass easy to manage in spring	Hessian fly may be a problem
Sorghum-sudangrass (Sorghum bicolor)	SA	All	35	Spring or: north of Rt. 1 by 10/1; south by 10/15	No later than 2 weeks prior to planting of next crop		High biomass producer in summer	
Annual ryegrass (Lolium spp.)	Spp. variation	All	20-30	Spring or Sept-Oct	No later than 2 weeks prior to planting of next crop	Fair to excellent nutrient and moisture scavenger	Tolerant to wide range of soil conditions , rapid establishment tolerate low pH and fertility, shade tolerant	Living mulch requires high management

[8] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial;
[9] Higher rates may be necessary for broadcast seedlings

	MIXTURES	Life Cycle [10]	Plant Hard. Zone	Seeding Rate [11] (lb/A)	Seeding Date	Killing Period	Value for Nutrient Mgt.	Comments[12]
1.	**Crimson clover with annual ryegrass**	WA/A	All	15 and 10	Spring or Aug-Sept.	No later than 2 weeks prior to planting of next crop	High	The annual ryegrass and crimson clover mix is a low cost cover crop option with multiple benefits. Both species establish slowly in the fall, but will grow vigorously in the spring. Annual ryegrass has tremendous root growth that will add to soil organic matter, improve soil structure, and prevent nitrogen leaching. Crimson clover will fix nitrogen, reducing the amount of N fertilizer needed the next year. This cover crop mixture makes excellent forage, cut or grazed in the spring.
2.	**Grain rye with oats**	A/A	All	80 and 70	North of Rt. 1 by 10/15; South of Rt. 1 by 11/1	No later than 2 weeks prior to planting of next crop	Moderate	The rye and oats mixture will maximize both fall and spring growth. Oats will grow rapidly in the fall, providing good soil coverage and nutrient uptake going in to the winter. The oats will winter-kill, but the rye in the mixture will persist and grow rapidly in spring, retaining nutrients, and improving the soil. The growth pattern of this mixture allows for forage production, either cut or grazed in both the fall and the spring.
3.	**Hairy vetch with rape and grain rye**	A/A/A	All	4, 10 and 80	Spring or Aug-Sept.	No later than 2 weeks prior to planting of next crop	High	This mixture combines three different plant families for enhanced biodiversity. Expect a dense stand in the spring because of the complementary growth habits- grassy, broadleaved, and vining. This should help to choke out weeds as well as provide significant additions of organic matter. Hairy vetch will fix nitrogen, reducing the amount of N fertilizer needed the next year. Both the hairy vetch and rape could be allowed to flower in the spring, attracting beneficial insects to the field. It could also be used for forage in the spring.

[10] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial
[11] Higher rates may be necessary for broadcast seedlings
[12] Mixtures and Comments source: Penn State Cooperative Extension

	MIXTURES (continued)	Life Cycle 13	Plant Hard. Zone	Seeding Rate 14 (lb/A)	Seeding Date	Killing Period	Value for Nutrient Mgt.	Comments15
4.	**Forage radish with hairy vetch and grain rye**	A/A/A	All	4, 10 and 80	Spring or Aug-Sept.	No later than 2 weeks prior to planting of next crop	High	This mixture also provides enhanced biodiversity with three different plant families represented. Tillage radish will grow rapidly in the fall, retaining nitrogen, and alleviating compaction with its roots. Tillage radish will winter-kill and leave a taproot hole that can enhance water infiltration into the soil in the spring and summer. Hairy vetch will fix nitrogen, reducing the amount of N fertilizer needed the next year. This mixture could be used for a forage in the spring
5.	**Forage radish with grain rye**	A/A	All	5 and 100	Spring or Aug-Sept.	No later than 2 weeks prior to planting of next crop	High	This cover crop mixture is an excellent choice in fall manured fields where retaining nitrogen through the winter is necessary. Tillage radish will grow rapidly in the fall, taking up nitrogen from the soil. Tillage radish winter-kills, releasing stored nitrogen which can be taken up by the rye when it starts to grow rapidly in the spring. The taproot hole left behind by tillage radish can enhance water infiltration into the soil

[13] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial
[14] Higher rates may be necessary for broadcast seedlings
[15] Mixtures and Comments source: Penn State Cooperative Extension

OTHER CROPS	Life Cycle [16]	Plant Hard. Zone	Seeding Rate [17] (lb/A)	Seeding Date	Killing Period	Value for Nutrient Mgt.	Advantages	Disadvantages
Buckwheat (Fagopyrum esculentum Moench)	SA	5&6	35-134	Spring or Sept-Oct.	No later than 1 week prior to planting of next crop	Fair-good nutrient scavenger (esp. P, Ca)	Grows on wide variety of soils (infertile, poorly tilled, low pH); rapid growth; quick smother crop and good soil conditioner; cool, moist climates; food and feed source	Limited growing season, frost sensitive; poor growth on heavy limestone soils; Occasional pests
Brassicas (Crucifera family) (e.g., rape, arugula, kale, turnip, forage radish)	A/B	6&7	5-12	Spring or Sept-Oct.	No later than 1 week prior to planting of next crop	Good nutrient scavenger (esp. N, P, Ca)	Quick establishment in cool weather; withstands light frost (but winter kills); deep, thick root systems; drought tolerant; highly digestible forage crop and other uses; continuous growth even with shorter days; may help insect and weed management	Helps reduce soil compaction; low tolerance to wet soils; potential bloat problems (mix with 25%° grass); long-term "weed" problem if allowed to set seed (spreads by seed); occasional pests; winter kills

[16] A=annual; WA=winter annual; SA=summer annual; B=biennial; SLP=short-lived perenial; LLP=long-lived perennial;

[17] Higher rates may be necessary for broadcast seedlings