USDA
NATURAL RESOURCES
CONSERVATION SERVICE

DELAWARE CONSERVATION
PRACTICE STANDARD

COVER CROP

CODE 340
(Reported by Ac.)

DEFINITION

Grasses, legumes, forbs, or other herbaceous plants established for seasonal cover and conservation purposes.

PURPOSES

This practice may be applied as part of a conservation management system to support one or more of the following resource concerns:

- To erosion from wind and water.
- To maintain or improve soil organic matter content.
- To manage the balance of plant nutrients.
- To manage excess nutrient in the soil profile.
- To provide soil moisture management.
- To manage plant pests (weeds, insects, and diseases).
- To provide supplemental forage
- To provide food and cover for wildlife.

CONDITIONS WHERE PRACTICE APPLIES

On all lands requiring vegetative cover for natural resource management.

CONSIDERATIONS

General

Using cover or green manure crops can provide both agronomic and environmental benefits, but will require more long-range planning and intensive management to maximize the benefits. The proper selection of plants to be used as a cover or green manure crop should be based upon intended objective.

Cover and green manure crops have associated long-term benefits that accrue slowly and thus cannot easily be evaluated for short term increased profits nor assigned a monetary value. These crops help retain nutrients in the soil/plant system, maintain or increase soil organic matter, and increase soil aggregation thus improving soil structure and tilth. Such soils then have increased water infiltration and water holding capacity, which ultimately leads to improved crop production potential.

Cover crop residues may interfere with seedbed preparation, temporarily tie-up nitrogen, or reduce seed germination by allelopathy. Spring management of cover and green manure crops is important to assure that succeeding crops are not hindered but benefit from the previous cover.

The effect of the cover and green manure crop on the nutrient and moisture status of the soil for the succeeding crop should be considered. This involves selecting the appropriate plant and kill dates for the particular crop or cropping system.

Consideration should be given for use of a pest management system for Hessian fly, powdery mildew, and other pests common to the cover crop. For fall plantings after a summer crop, an early planting of cereal grain cover crops may lead to a higher incidence of disease and insects in nearby grain production fields. Covers can also harbor certain pests or crop pathogens for the following crop and should not be grown just before or adjacent to susceptible crops. Conversely, some cover crops may help control certain pests for the major crop to be grown.

Costs of seed, fuel, pesticides, labor and management to plant, maintain, and incorporate or kill the cover or green manure crop need to be considered.

Consider the effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and groundwater recharge.

The filtering effects of the vegetation on movement of sediment, pathogens, and soluble and sediment adsorbed substances carried by runoff should be taken into consideration.

Cover Crops for Erosion Control and Soil Protection

For seasonal cover crops, annual grasses are most commonly used alone, and they give satisfactory results at a reasonable cost. Summer annual grasses and legumes may be used as a "half-season" cover crop after an early vegetable crop, small grain, or before a late crop. A summer annual is commonly used to control weeds while land is out of production for a short period of time.

Cereal grain and legume mixtures provide better ground cover for improved soil erosion control than either used alone. In addition, sowing legumes with a companion grass can assist winter survival of the legume. Soil freezing and thawing causes heaving, in which the crowns of taprooted crops like clover are forced out of the ground, often killing the plants. The fine roots and shoots of the grass help minimize this frost heaving. A third advantage is that a mixture combines the nutrient immobilizing ability of the cereal grain (although at a lower rate than if seeded alone) with the nitrogen fixing attribute of the legume, and thus can adjust to varying residual soil nitrate levels. Subsequently, the potential for nitrate leaching below the root zone is reduced and inorganic nitrogen applications for the following crop are lowered.

For regions with shorter growing seasons, timely establishment of cover crops may be difficult. A "living mulch" that provides permanent, living ground cover in which other crops are planted can be used to overcome this constraint. Crownvetch and flatpea have been shown to be excellent living mulches but they require precise management by the operator to assure long term benefits.

For orchards, vineyards, and nurseries, permanent vegetative covers are usually preferred. Permanent covers of grass/legume mixtures provide the best soil protection and provide stable support for equipment used in these farm operations. It is best to establish cover 1 to 2 years before planting the orchard or vineyard, and strip-kill the cover with herbicides or cultivation prior to tree/shrub/vine planting. This provides maximum soil protection from erosion, improved water infiltration, and improved soil structure for enhanced growth of the primary crop. Refer to Table 2 for permanent vegetative cover recommendations.

Cover Crops for Nutrient Assimilation

Elevated root zone nitrate levels can persist following harvest of the primary crop. The presence of significant quantities of nitrate in upper soil horizons at the onset of the fall-winter groundwater recharge period raises the potential for nitrate leaching below the root zone.

Winter annual grasses, primarily the cereal grains, immobilize significant quantities of residual nitrogen left from the previous crop. This can reduce the potential for nitrate leaching to the groundwater. This situation is most prevalent with continuous corn or corn/soybean rotations. A grass or grass/legume cover crop can be used to take up excess plant nutrients to prevent their movement below the root zone. Also, where organic waste applications are made in the fall and winter, grass cover crops are the best choice for nutrient uptake. However, cover crops may not always be able to take up enough of the nitrogen from the organic wastes applied in late fall and winter to prevent nitrate-nitrogen leaching.

For nutrient assimilation, the primary concern is to establish the cover crop within the designated seeding periods. The earlier the planting in the fall, the more growth and nutrient uptake will occur before the winter dormant period arrives.

The efficiency of using residual nitrogen in the fall (in decreasing order) is: rye, wheat, barley, oats. These cereal grains, particularly rye, do well in all areas of the state. Rye serves as the

most effective sink for residual nitrogen because of its extensive, fibrous root system and its ability to grow in cool temperatures in late fall, winter, and early spring. However, nitrogen immobilized by a cereal grain cover crop is largely unavailable for a subsequent crop since the mineralization rate during plant decomposition is generally slow. Nitrogen becomes mineralized more rapidly when the cover crop is killed early in the spring when it is succulant, about a month prior to planting the next crop.

Green Manure Crops for a Nutrient Source

Winter annual legumes may be used as a nitrogen source for a succeeding summer crop. Their use can reduce purchased fertilizer inputs. Three winter annual legume crops that provide significant amounts of nitrogen for the next crop are (in decreasing order): hairy vetch, Austrian winter peas, and crimson clover. Other legumes may be used, but most supply smaller quantities of nitrogen.

Hairy vetch performs well in all areas of the state. Most of the legumes listed in Table 1 are well suited to the Coastal Plain, but only hairy and bigflower vetch, Austrian winter peas, and possibly crimson clover are adaptable to other areas of the state. In cropping systems that include small grain, crimson clover or Austrian winter peas are the preferred legumes because of the potential weed problem associated with hairy vetch. In continuous corn production, the reseeding characteristics of hairy vetch could actually be an asset.

Biennial and perennial legumes, although useful for supplying nitrogen and providing ground cover protection for the soil, are best suited as permanent covers, pasture and hay crops in long-term rotations and should not be planted and utilized as annual covers. Crownvetch and flatpea, however, can be used as a living mulch but require precise management to maintain the permanent stand and not interfere with producing the primary crop.

Credit for nitrogen contributions from legume crops in rotation shall be consistent with current University of Maryland Cooperative Extension Service recommendations. However, while legumes can supply large amounts of nitrogen to the summer crop, they provide minimum protection for nitrate leaching from the root zone when compared with cereal grains and other grasses.

All cover and green manure crops can provide nutrients and organic matter to the soil. Cereal grains, annual ryegrass, millet, sudangrass, and sorghum-sudangrass hybrids serve as good green manure crops. Grasses generally produce more dry matter than legumes, but they also decompose slower and are less efficient in conserving soil moisture than legumes. Grass/legume mixtures produce more dry matter, provide better early ground cover, and eventually more mulch for soil moisture conservation than either component grown alone.

General (for all purposes)

The proper selection of plants is dependent upon which primary objective is to be achieved**. The** recommended cover and green manure crops, approved seeding rates and optimum time of planting and killing are listed in Table 1.

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 wide-row crops before harvesting the primary crop. Overseeding allows the cover crop to get a head start and provides soil coverage when the primary crop is harvested.

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.

Legume seeds shall be inoculated with the appropriate species of Rhizobia, the bacteria that forms nodules on legume roots, converting atmospheric nitrogen into the plant available form.

Spring management of cover crops is very important to prevent difficulties with the next crop. The cereal grain cover or green manure crop can be killed at various growth stages, depending on the producer's objective. If forage is desired, green-chop or graze the crop in the late boot to

early head stages when optimal nutritional content and yield is obtained. If forage is not needed, kill the cover no later then the late joint to early boot stages, or no later than 2-4 weeks before planting the next crop. This timing of the kill date permits maximum growth of the cover and maximum uptake of residual nutrients while allowing sufficient time for the decomposition of the vegetation, release of nutrients, and recharge of the soil moisture.

Cover Crops for Erosion Control and Soil Protection

Early seeding, quick germination, vigorous growth, and uniform soil coverage are some of the key criteria where cover crops are used to provide erosion control and soil protection.

Seeding cover crops as early as possible will usually 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 the winter dormant season begins. 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 begins.

Quick germination of seed helps to overcome seedings done later in the planting period. When later seedings are needed, select a cover crops that will germinate rapidly to help assure a successful stand. Annuals generally germinate more rapidly than perennials, and grasses generally germinate more rapidlythan legumes. The most rapid germinating seed listed on Table 1 are annual ryegrass, spring oats, and millet, followed by winter wheat and rye, and sudangrass.

To perform satisfactorily, cover crops must provide at least 70% soil surface coverage during the critical erosion or water runoff period. Uniform soil coverage is generally a function of method of seeding. For best results, seeds should be placed at a controlled depth with the soil firmed around the seed. This will give good seed-soil contact, necessary for providing sufficient moisture for seed germination and growth. Drilling the seed provides the best seeding method and uniform soil coverage can be assured. Broadcasting seed by hand, cyclone seeder, helicopter or airplane, or other methods result in poorer germination and cover, and require higher seeding rates to compensate and provide good soil coverage. See Table 1 or 2 for seeding methods.

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

Cover Crops for Nutrient Assimilation

Early seeding, quick germination, vigorous growth, uniform soil coverage, and proper management in the spring are some of the key criteria where cover crops are used for nutrient assimilation.

Seeding cover crops as early as possible will usually 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. It is vital that the seeding be no later than the seeding period so that sufficient growth occurs before the winter dormant season begins.

Quick germination of seed helps to overcome seedings done later in the planting period. When later seedings are needed, select a cover crops that will germinate rapidly and provide suitable growth in late fall/early winter**.** The most rapid germinating seed listed on Table 1 are annual ryegrass and spring oats, followed by winter wheat and rye. Rye is preferred, however, because is provides the most growth in cooler temperatures.

To perform satisfactorily, cover crops must provide at least 80% soil surface coverage during the critical leaching period of late fall and winter. Uniform soil coverage is generally a function of method of seeding. For best results, seeds should be placed at a controlled depth with the soil firmed around the seed. This will give good seed-soil contact, necessary for providing sufficient moisture for seed germination and growth.

Drilling the seed provides the best seeding method and uniform soil coverage can be assured. Broadcasting seed by hand, cyclone seeder, helicopter or airplane, or other methods result in poorer germination and cover, and require higher seeding rates to compensate and provide good soil coverage. See Table 1 for seeding methods.

Spring management of cover crops is very important to prevent difficulties with the next crop. The cover crop can be killed at various growth stages, depending on the producer's objective. If forage is desired, green-chop or graze the crop in the late boot to early head stages when optimal nutritional content and yield is obtained. If forage is not needed, kill the cover no later then the late joint to early boot stages, or no later than 2-4 weeks before planting the next crop. This timing of the kill date permits maximum growth of the cover and maximum uptake of residual nutrients while allowing sufficient time for the decomposition of the vegetation, release of nutrients, and recharge of the soil moisture.

Green Manure Crops for a Nutrient Source

Plant selection, early seeding, vigorous growth, uniform soil coverage, and proper management in the spring are some of the key criteria where cover crops are used as a nutrient source.

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. Three winter annual legume crops that provide significant amounts of nitrogen for the next crop are (in decreasing order): hairy vetch, Austrian winter peas and crimson clover. Other legumes may be used, but most supply smaller quantities of nitrogen. All species listed on Table 1 have vigorous growth capabilities.

Seeding cover crops as early as possible will usually 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. It is vital that the seeding be no later than the seeding period so that sufficient growth of the legumes occurs before the winter freeze-thaw period begins.

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. For best results, seeds should be placed at a controlled depth with the soil firmed around the seed. This will give good seed-soil contact, necessary for providing sufficient moisture for seed germination and growth. Drilling the seed provides the best seeding method and uniform soil coverage can be assured. Broadcasting seed by hand, cyclone seeder, helicopter or airplane, or other methods result in poorer germination and cover, and require higher seeding rates to compensate and provide good soil coverage. See Table 1 for seeding methods.

Spring management of cover crops is very important to prevent difficulties with the next crop. The cover crop can be killed at various growth stages, depending on the producer's objective. Legumes continue to fix nitrogen until they mature, so they may be kept growing as long as practical to maximize nutrient production. Legumes killed while succulant decompose more rapidly than grasses, so killing the legume cover 5 - 10 days before planting the next crop is sufficient to obtain the correct soil moisture conditions and facilitate good seed-soil contact.

SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail concerning site preparation and establishment to ensure successful management of the practice. Appropriate conservation practice standards shall be used for designing and installing structural and vegetative measures. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

Establishment

To establish this practice, the operator must do the following for the intended purpose of the cover and green manure crop:

1. Cover Crops for Erosion Control and Soil Protection

    a. Temporary or Seasonal Cover

        1. Planting Time — 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.

        2. Lime — An excellent time to apply lime needed by the primary (next) crop is when the cover crop is established. This allows the lime to begin reacting with the soil, adjusting the pH before the next crop is grown. Apply lime according to soil test to obtain the desired pH level for the production crop.

        3. Fertilize — Apply fertilizer according to soil test. Additional fertilizer is usually not necessary because there are sufficient nutrient residuals from the previous crop.

        4. Seedbed Preparation — Prepare seedbed by chiseling or disking when planting with a conventional drill or broadcasting. No preparation is needed when using a no-till seeder. When overseeding into a standing crop, preparation of the seedbed is usually not possible except when done during the last cultivation procedure.

        5. Plant Selection and Seeding Rate — Select plant species and the appropriate seeding rate from Table 1. Selection will be based upon time of year, availability and cost of seed, and geographic location. Adjust seeding rate depending on method of planting.

    b. Permanent or Perennial Cover

        1. Planting Time — Plant the perennial cover within the time period indicated on Table 2. This may be immediately after removing the previous crop, trees, shrubs, or vines, or it may be an overseeding in existing plantations. It is best to establish cover 1 to 2 years before planting the primary crop, new orchard, or vineyard, when possible.

        2. Lime — An excellent time to apply lime needed by the primary (next) crop is when the cover crop is established. This allows the lime to begin reacting with the soil, adjusting the pH before the next crop is grown. Apply lime according to soil test to obtain the desired pH level for the production crop.

        3. Fertilize — Apply fertilizer according to soil test. Additional fertilizer is usually necessary when planting a perennial cover because there are not sufficient residuals from the previous crop to assure adequate growth of the cover.

        4. Seedbed Preparation — Prepare seedbed and plant seed in the following ways:

            a. Where no trees, shrubs, or vines exist in the field, conventional cultivation and planting methods, and no-till methods, are satisfactory.

b. Where trees, shrubs, or vines exist and an overseeding is needed, prepare seedbed between the rows by a light disking to avoid damage to roots and plant with a drill or broadcast seeder, or use no-till.

5. Plant Selection and Seeding Rate — Select plant species and the appropriate seeding rate from Table 2. Selection will be based upon time of year, availability and cost of seed, and geographic location. Adjust seeding rate depending on method of planting.

2. Cover Crops for Nutrient Assimilation

a. Planting Time — 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.

b. Lime — An excellent time to apply lime needed by the primary (next) crop is when the cover crop is established. This allows the lime to begin reacting with the soil, adjusting the pH before the next crop is grown. Apply lime according to soil test to obtain the desired pH level for the production crop.

c. Fertilize — Do not apply fertilizer. The intent is for the cover crop to use the residual nutrients from the previous crop.

d. Seedbed Preparation — Prepare seedbed by chiseling or disking when planting with a conventional drill or broadcasting. No preparation is needed when using a no-till seeder. When overseeding into a standing crop, preparation of the seedbed is usually not possible.

e. Plant Selection and Seeding Rate — Select plant species and the appropriate seeding rate from Table 1. Selection will be based upon time of year, availability and cost of seed, and geographic location. Adjust seeding rate depending on method of planting.

3. Green Manure Crops for a Nutrient Source

a. Planting Time — Plant the green manure 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.

b. Lime — An excellent time to apply lime needed by the primary (next) crop is when the cover crop is established. This allows the lime to begin reacting with the soil, adjusting the pH before the next crop is grown. Apply lime according to soil test to obtain the desired pH level for the production crop.

c. Fertilize — Apply fertilizer according to soil test. Additional fertilizer is usually not necessary when planting because there are sufficient residuals from the previous crop to assure adequate growth of the cover.

d. Seedbed Preparation — Prepare seedbed by chiseling or disking when planting with a conventional drill or broadcasting. No preparation is needed when using a no-till seeder. When overseeding into a standing crop, preparation of the seedbed is usually not possible.

e. Plant Selection and Seeding Rate — Select plant species and the appropriate seeding rate from Table 1. Selection will be based upon time of year, availability and cost of seed, and geographic location. Hairy vetch, Austrian winter peas, and crimson clover provide the most nitrogen for the next crop. Adjust seeding rate depending on method of planting. Inoculate legume seed with the appropriate Rhizobia bacteria, following the manufacturer's recommendations.

OPERATION AND MAINTENANCE

To correctly operate and maintain this practice, the operator must perform the following actions for the intended purpose of the cover and green manure crop:

1. Temporary Cover Crops for Erosion Control and Nutrient Management

   a. Soil Coverage — Cover crops must provide at least 70% soil coverage during the critical erosion or water runoff period for satisfactory erosion control. Cover crops must provide at least 80% soil coverage for nutrient management purposes, but greater coverage is preferred to assure that uniform nutrient management benefits are derived.

   b. Method and Timing of Cover Kill — Spring management of cover crops, especially with grasses, is very important to prevent difficulties with the next crop. Method of kill can be with cultivation, forage harvest, or herbicides.

      1. The grass cover crops can be killed at various growth stages, depending on the producer's objective. If forage is desired, green-chop or graze the grass in the late boot to early head stages when optimal nutritional content and yield is obtained. If forage is not needed, kill the cover no later then late joint to early boot stages. For either situation, kill the grass no later than 2-4 weeks before planting the next crop. This timing of the kill date permits maximum growth of the grass and maximum uptake of residual nutrients while allowing sufficient time for the decomposition of the vegetation, release of nutrients, and recharge of the soil moisture.

      2. The legume covers used for cover and green manure crops are usually not harvested for forage. Legumes continue to fix nitrogen until they mature, so they may be kept growing as long as practical to maximize nutrient production. Legumes killed while succulant decompose more rapidly than grasses, so killing the legume cover 5 - 10 days before planting the next crop is sufficient to obtain the correct soil moisture conditions and facilitate good seed-soil contact.

2. Permanent Cover Crops for Erosion Control

   a. Soil Coverage — Cover crops must provide at least 70% soil coverage during the critical erosion or water runoff period for satisfactory erosion control. Cover crops must provide at least 80% soil coverage to adequately support farming equipment between tree, shrub, and vine rows.

   b. Managing Plant Residues — The use of grasses, legumes, and their plant residues around trees, shrubs, and vines may provide areas for rodents and small mammals to hide and eat the main stem of the production stock. This condition may also cause competition for soil moisture. Either of these conditions can cause reduced plant growth and yields, and can be eliminated by strip-killing the permanent cover crop 1 to 2 feet around the main stem of the production crop. Strip-kill by use of cultivation equipment that will not damage the production crop roots, or with herbicides. This step may be required several times during the growing season, but especially in the spring during the bud swelling period, in the flower pollination stage, and in the fall bud formation period to reduce moisture competition.

   c. Other Maintenance — The permanent vegetative cover should be managed like any other permanent cover. Periodic mowing is needed to reduce weeds, insects, and other pests, and to promote growth and uniform soil coverage by the perennial cover. A soil test should be taken at least every 3 years and the soil pH should be adjusted as needed. Annual application of fertilizer is acceptable to provide the necessary nutrients for the long-term growth of the cover crop.

      For legumes used as permanent living mulches, killing the cover crop is not done. However, the living mulch legume may need to be suppressed by mowing or herbicide treatment prior to planting the primary crop so that the primary crop is able to outgrow the living mulch.

Crownvetch and flatpea does not provide severe competition with corn because these legumes have a longer period of dormancy in the spring and have little foliage when corn is planted.

SUPPORTING DATA AND DOCUMENTATION

Record and maintain the following data for cover and green manure crops. This data will be included in the conservation plan or case file:

1. Field location and acres - Conservation plan narrative and plan map, or on the SCS-CPA-6 form.
2. Purpose of practice, species used, method and rate of seeding, date seeded, and date killed - Conservation plan narrative, or on the SCS-CPA-6 form, or on a practice design sheet.
3. Soil loss reduction calculations if the purpose was erosion control.

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