

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**  
**FORAGE HARVEST MANAGEMENT**

(Ac.)

**CODE 511**

**DEFINITION**

The timely cutting and removal of forages from the field as hay, green-chop, or ensilage.

**PURPOSE**

This practice may be applied for one or more of the following purposes:

1. To optimize yield and quality of forage at the desired levels;
2. To promote vigorous plant re-growth;
3. To manage for the desired species composition;
4. To use forage plant biomass as a soil nutrient uptake tool;
5. To control diseases, insects, and weeds;
6. To maintain and/or improve wildlife habitat.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice may be applied on all land uses where machine-harvested forage crops are grown. This practice may be used in combination with Prescribed Grazing (528) in fields where forage is harvested both mechanically and by grazing animals. This practice may also be used in combination with Conservation Crop Rotation (328) in fields where hay is grown in rotation with other crops.

This practice does not apply to establishing forage crops. Refer to the conservation practice standard for Forage and Biomass Planting (512).

**CRITERIA**

**General Criteria Applicable to All Purposes**

Forage shall be harvested at a frequency and height that optimizes the desired forage stand, plant community, and stand life. Follow Delaware Cooperative Extension recommendations for forage harvest based on stage of maturity, moisture content, length of cut, stubble height, and harvest interval.

**Stage of Maturity.** Harvest forage at the stage of maturity that provides the desired quality and quantity without compromising plant vigor and stand longevity. Most forage crops decline in nutritive value as they mature. If harvested at a later stage of maturity, use the forage for livestock that have lower nutritional needs or balance the feed ration by utilizing supplements.

Harvest new plantings when sufficient growth is present and plant roots are sufficiently established to ensure adequate food reserve storage for overwintering and vigorous spring growth. Avoid fall harvest of late season plantings because adequate re-growth will not occur before the first killing frost.

Harvest established stands according to the guidelines in the 511 Implementation Requirements worksheet. Avoid harvesting forage whose quality is not suitable for optimum health and productivity of the livestock being fed.

Delay harvest if prolonged or heavy precipitation is forecast that would significantly damage cut forage. When weather conditions make it difficult to harvest the desired quality of forage, use mechanical or chemical conditioners or ensile the forage to maintain quality.

**Moisture Content.** Harvest silage and hay crops within the optimum moisture range for the type of storage method(s) or structure(s) being utilized.

When direct-cut hay crop silage is harvested at moisture content greater than 70 percent, treat with chemical preservatives or add dry feedstuffs to avoid fermentation and loss of digestible dry matter due to seepage.

For optimum dry hay quality, rake, ted (spread out), or invert swaths when cut hay has reached an appropriate moisture level to prevent leaf loss. Rake hay when the moisture content is 30 to 40 percent. Ted or invert swaths when the moisture content is above 40 percent.

Bale at appropriate moisture levels to retain forage quality and quantity. Use the guidelines in the 511 Implementation Requirements worksheet to determine the moisture content for various storage methods.

**Length of Cut.** When harvested for ensilage, chop forage to a size appropriate for the type of storage structure (high moisture wrapped or tube bales) that allows adequate packing to produce the anaerobic conditions necessary to ensure the proper ensilage process.

**Stubble Height.** Cut forages at a height that will promote the vigor and health of the desired plant species. Use cutting heights that will provide adequate residual leaf area; adequate numbers of terminal, basal, or axillary tillers or buds; sufficient insulation from extreme heat or cold; and/or unsevered stem bases to store food reserves needed for full, vigorous recovery. Leave a 2 to 3-inch stubble height for Kentucky bluegrass, 3 to 4 inches for other perennial cool-season grasses and legumes, and 4 to 6 inches for perennial warm-season grasses.

**Contaminants.** Forage shall not contain contaminants at levels harmful to the health of the livestock being fed. Contaminants are any objectionable matter or toxin that can cause illness, miscarriage, death, or rejection of the offered forage.

### **Additional Criteria to Promote Plant Regrowth and Maintain Desired Species Composition**

**Soil pH and Fertility Levels.** Based on soil test results, apply lime and fertilizer to forage crops to meet desired yield goals, promote plant regrowth, and help maintain the life of the stand. The use of commercial fertilizer and other forms of plant nutrients must be in compliance with Delaware nutrient management regulations, as applicable, and shall meet the requirements of the Delaware conservation practice standard for Nutrient Management (590).

**Stage of Maturity and Harvest Interval.** Cut forage plants at a stage of maturity or harvest interval that will provide adequate food reserves and/or basal or auxiliary tillers or buds for regrowth and/or reproduction to occur without loss of plant vigor.

Cut reseeding annuals at a stage of maturity and frequency that ensures the production of ample viable seed or carryover of hard seed to maintain desired stand density.

If plants show signs of short-term environmental stress, adjust management to ensure the continued health and vigor of the stand.

Manipulate timing and cutting heights of harvest to ensure germination and establishment of reseeding or seeded annuals.

### **Additional Criteria for Using Forage Plant Biomass as a Nutrient Uptake Tool**

Use a harvest regime that utilizes the maximum amount of available or targeted nutrients from the site. Maximizing nutrient uptake may require more frequent harvests to remove nutrients as compared to managing for stand longevity.

For fields with one or more nutrients testing in high or excessive amounts, harvest as needed to bring accumulated soil nutrients within the agronomic optimum soil test range. Also, when practical and consistent with the producer's objectives, replant with species that require high levels of targeted nutrients. Refer to the Agricultural Waste Management Field Handbook for information concerning plant nutrient uptake by forage crops.

### **Additional Criteria to Control Diseases, Insects, and Weeds**

Schedule harvest periods as needed to help control insects, diseases, and weeds.

To reduce incidence of disease, insect damage, and weed infestation, manage harvests to maintain a full, vigorous, dense forage stand. To the extent feasible, manage the stand to encourage plant diversity in order to minimize problems due to species-specific pests.

To control forage plant diseases, insects, and movement of weeds, clean harvesting equipment after harvest and before storing. Cut forages after dew, rain, or irrigation water on leaves has evaporated.

When diseases, insects, or weed infestations exceed the economic threshold and cannot be controlled by forage harvest management alone, use appropriate integrated pest management techniques. Refer to the conservation practice standard for Integrated Pest Management (595).

For specific pest management recommendations, contact the appropriate specialist from Delaware Cooperative Extension, the Delaware Department of Agriculture, or a licensed commercial pest management consultant. Adhere to the specific days to harvest period stated on the pesticide label. Control noxious weeds as required by state law.

### **Additional Criteria to Maintain and/or Improve Wildlife Habitat**

When the client's objectives include wildlife habitat, use appropriate harvest schedules and maintain plant heights to provide suitable habitat for the desired species. When feasible, manage the stand to favor a diverse mix of grasses, forbs, and legumes to provide food and cover for wildlife.

Provide nesting habitat by deferring mowing and harvest operations during the primary nesting season (April 15 to August 15). Leave field edges unharvested and undisturbed for a minimum width of 35 feet, or if feasible, leave the entire field unharvested during this period.

Use harvesting patterns that provide escape routes for wildlife. Begin on one side of the field and work back and forth across the field toward the other side (edge to edge), or begin in the center of the field and work outward (inside to outside).

For additional criteria and wildlife species information, refer to the conservation practice standard for Upland Wildlife Habitat Management (645) and to fact sheets and other publications (see the References section of this standard).

*Note: Specific programs may dictate criteria in addition to, or more restrictive than, those specified in this standard.*

### **CONSIDERATIONS**

Consider that proper timing of harvest, height of harvest, and application of organic amendments can promote soil health. When pastures and haylands are properly managed, grazing and harvesting will leave enough residual material that plants that can recover and re-grow. The plants are healthier, will increase soil organic matter, and improve the structure of the soil.

When plants are growing rapidly, pastures may produce forage in excess of livestock demand. Consider machine-harvesting a portion of the standing crop to retain forage quality and properly store excess forage production.

Consider harvesting forages in the afternoon to optimize water soluble carbohydrates and nutritional quality.

In conjunction with harvest operations, consider storage and feeding options that will retain acceptable forage quality and minimize loss of digestible dry matter, such as storing the bales off the ground, covering the bales, or wrapping large, round bales.

When rainfall and/or humidity levels are high, consider ensiling cut forage to reduce forage quality losses and eliminate field-drying time. Other options include: (1) the use of desiccants, preservatives, or conditioners; macerating or fine-chopping implements; or barn-curing techniques to reduce drying time; or (2) the use

of green-chopping or grazing to improve the timeliness of harvest and maintain forage quality.

Direct-cut grass and legume silage can produce silage leachate (seepage). Consider the need for collection, storage, and disposal of this leachate as part of an agricultural waste management system.

Care should be taken to produce stored forages of the quality needed for optimum performance of the animal being fed. For instance, immature legume forages can be too low in fiber and lead to metabolic disorders in ruminants and an economic loss to the producer due to lowered animal performance.

Consider analyzing harvested forages for feed quality. An excess or improper balance of nutrients, such as nitrogen, can produce plant material that causes toxicity in some animals. Forage testing is recommended, especially for forages that are harvested from fields with high to excessive nutrient levels. As appropriate, based on test results, balance feed rations by using the actual nutrient content of the forage instead of “assumed” or “average” values.

When wildlife habitat is a concern, mechanical harvesting schedules and wildlife nesting schedules are often incompatible. It usually is not economically feasible to leave entire fields unharvested for long periods, but the longer the intervals between harvests, the better for wildlife. Generally, habitat for ground-nesting birds and other wildlife is best provided in production hayfields by leaving field edges unharvested and undisturbed during the primary nesting season (April 15 to August 15). For optimum results, unharvested strips should be at least 50 feet wide, preferably adjacent to woody cover.

Take note of other constraints such as economic feasibility, available equipment, access, capacity of storage areas, program requirements, social effects, and visual aspects.

## **PLANS AND SPECIFICATIONS**

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice, and may be

recorded in narrative form on Implementation Requirements (IR) worksheets, fact sheets, or other approved forms.

The appropriate fact sheet(s) and completed 511 IR worksheet can serve as the plan and specifications for this practice. Specify the following by forage crop:

1. Purpose of forage production;
2. Forage harvest guidelines that include stage of maturity for harvest and average number of cuttings expected per year;
3. Stubble height following harvest;
4. Moisture content goal at harvest;
5. Storage method.

## **OPERATION AND MAINTENANCE**

An Operation and Management (O&M) plan shall be prepared and is the responsibility of the client to implement. The appropriate fact sheet(s) and IR worksheet may serve as the management plan, as well as supporting documentation, and shall be reviewed with and provided to the client.

At a minimum, the following components shall be addressed in the O&M plan, as applicable:

1. Before forage harvest, clear fields of debris that could damage equipment or, if ingested by livestock, lead to sickness or death;
2. To control the spread of forage plant diseases and weeds, clean harvesting equipment after harvest and before storing;
3. Do not cut forage until dew, rain, or irrigation water on leaves has evaporated. Monitor weather conditions and take action accordingly before and after cutting to optimize forage wilting or curing time, maintain forage quality, and prevent forage swaths or windrows from smothering underlying plants;
4. Minimize the time large or small bales of cured forage are allowed to remain drying in the field. This will prevent smothering of underlying plants and subsequent weed invasion of the damaged areas;

5. To insure adequate root reserves, allow plants to reach an appropriate height before the first killing frost;
6. Check for disease, insect damage, and weed infestations. If an incidence threatens stand survival, take corrective action to keep the pest under control. To the extent feasible, “spot” spray or mow to control weeds, so that desirable plants are not destroyed unnecessarily. Control noxious weeds as required by state law;
7. Where wildlife habitat is a concern, use the following harvesting techniques:
  - a. Provide nesting habitat by deferring mowing and harvest operations during the primary nesting season (April 15 to August 15). Leave field edges unharvested and undisturbed for a minimum width of 35 feet. For optimum results, unharvested strips should be at least 50 feet wide, preferably adjacent to woody cover, or leave the entire field unharvested during the primary nesting season;
  - b. Use harvesting patterns that provide escape routes for wildlife. Begin on one side of the field and work back and forth across the field toward the other side (edge to edge), or begin in the center of the field and work outward (inside to outside).
8. Apply soil amendments periodically, based on soil test results, if needed to meet desired yield goals, promote plant regrowth, and help maintain the life of the stand. The use of commercial fertilizer and other forms of plant nutrients must be in compliance with Delaware nutrient management regulations;
9. Regardless of silage storage method, ensure good compaction and an airtight seal to exclude oxygen and mold formation. Do not seal hay, because it can result in heat build-up, moisture, and mold problems;
10. Describe the time of year or frequency of use restrictions, if any. *Pay particular attention to program requirements as they relate to acceptable vs. restricted uses and other management restrictions.*

## SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location of the practice on the conservation plan map;
2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom;
3. Completed IR worksheet, and copy of the appropriate fact sheet(s) or other specifications and management plans.

## REFERENCES

1. Johnson, Quintin, Mark VanGessel, Richard W. Taylor. 2014. *Pasture and Hay Weed Management Guide*. Delaware Cooperative Extension, University of Delaware.
2. Maryland Cooperative Extension. *Wildlife Management Fact Sheets*. <https://extension.umd.edu/tags/wildlife-management>
3. Penn State University, College of Agricultural Sciences. 2015. *The Agronomy Guide*. <http://extension.psu.edu/agronomy-guide>
4. Penn State University, College of Agricultural Sciences. *Forage Crops*. <http://extension.psu.edu/plants/crops/forages>
5. USDA, Natural Resources Conservation Service. *Conservation Practice Standards*. Delaware Field Office Technical Guide, Section IV.
6. USDA, Natural Resources Conservation Service. *Fish and Wildlife Habitat Leaflets and Technical Notes*. <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/fishwildlife/pub/>
7. Virginia Tech Extension. *Pasture & Forage – Crops & Soils*. Publications and Educational Resources. <https://pubs.ext.vt.edu/category/pasture-forage-cs.html>