NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
FORAGE AND BIOMASS HARVEST MANAGEMENT
(Ac.)
CODE 511

DEFINITION
The timely cutting and removal of herbaceous species from the field as hay, green-chop, ensilage or biomass.

PURPOSE
- Optimize yield and quality of forage at the desired levels
- Promote vigorous plant re-growth
- Maintain stand life
- Manage for the desired species composition
- Use forage plant biomass as a soil nutrient uptake tool
- Control insects, diseases and weeds
- Maintain and/or improve wildlife habitat
- Harvest biomass for energy production

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to all land uses where machine harvested forage or biomass crops are grown. For harvesting agronomic crop residues for biomass (e.g. corn, wheat, etc.) use the Tillage and Residue Management practices (329, 344, 345, 346) as appropriate.

CRITERIA
General Criteria Applicable to All Purposes
Forage will be harvested at a frequency and height that will maintain a desired healthy plant community. State Cooperative Extension Service forage harvest recommendations based on stage of maturity, moisture content, length of cut, stubble height and harvest interval shall be used to meet the following criteria.

Stage of Maturity. Harvest forage at the stage of maturity that provides the desired quality and quantity for the livestock being fed; harvest biomass at the stage of maturity that provides the desired quality and quantity for the intended use. Harvest must not compromise plant vigor and stand longevity.

Moisture Content. Harvest silage/haylage crops within the optimum moisture range for the type of storage structure(s) being utilized. (See Table 2)
State Cooperative Extension Service recommendations for optimum moisture content and levels as well as methods and techniques to monitor and/or determine moisture content and levels will be followed.

Treat direct-cut hay silage (moisture content >70%) with chemical preservatives or add dry feedstuffs to avoid fermentation and seepage losses of digestible dry matter.

For optimal dry hay quality, rake hay at 30 to 40 percent moisture and ted or invert swaths when moisture is above 40 percent to prevent leaf loss.

To preserve forage quality and quantity, bale field cured hay at 15 – 20 percent moisture and bale forced air-dried hay at 20 – 35 percent moisture.

Length of Cut. When harvested for ensilage forage will be chopped to a size appropriate for type of storage structure used and optimal effective fiber. The length of chop selected will allow adequate packing to produce the anaerobic conditions necessary to ensure the proper ensiling process.
Contaminants. Forage shall not contain contaminants that can cause illness or death to the animal being fed or rejection of the offered forage. For more information on contaminants and toxins see National Range and Pasture Handbook Ch. 5, Sect. 2, 57-58.

Additional Criteria to Improve or Maintain Stand Life, Plant Vigor and Forage Species Mix

Stage of Maturity and Harvest Interval. Cut forage plants at a stage of maturity or harvest interval range 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 (see Table 1). Harvesting early will improve quality but may reduce stand life if done repeatedly. Harvesting a little later lowers quality, but increases yield, builds food reserves, allows basal buds to break dormancy, and increases stand life. More frequent harvests tend to decrease overall yield, reduce plant vigor, and lead to a progressive stand decline.

When grasses and legumes are grown together, the legume stage of maturity is used to time the harvest except in the case of birdsfoot trefoil, kura clover, and white clovers. White clovers, kura clover, and birdsfoot trefoil tend to maintain their quality because they are indeterminate in their flowering and growth.

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

If plants show signs of short-term environmental stress, management will be applied in a manner that encourages the continued health and vigor of the stand.

Stubble Height. Cut forage plants at a height that will promote the vigor and health of the desired species. Cutting heights will provide adequate residual leaf area; adequate numbers of terminal, basal or auxiliary tillers or buds; insulation from extreme heat or cold; and/or uncut stem bases that store food reserves needed for full, vigorous recovery (see Table 1).

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

Additional Criteria for Use as a Nutrient Uptake Tool

Employ a harvest regime that utilizes the maximum amount of available or targeted nutrients. For specific nutrient uptake, select forage species that can maximize uptake. Using this practice for this purpose may require more frequent harvests to increase uptake instead of managing for stand longevity.

Additional Criteria to Control Disease, Insect, Weed and Invasive Plant Infestations

Follow Extension Service guidelines when available for control of disease, insect, weed and invasive plant infestations.

Schedule harvest periods to control disease, insect, and weed infestations. When a pesticide is used to control disease, insects or weeds, adhere to the specified days-to-harvest period stated on the pesticide label. Evaluate pest management options by planning conservation practice standard Integrated Pest Management (595). Plan and schedule removal of invasive plants and noxious weeds.

Lessen incidence of disease, insect damage, and weed infestation by managing for desirable plant vigor. Prescribed Burning (338) may be used as a tool for weed control and to stimulate plant vigor for some species.

Additional Criteria to Improve Wildlife Habitat Values

If client objectives include providing suitable habitat for wildlife then appropriate harvest schedule(s), cover patterns, and plant height to provide suitable habitat for the desired specie(s) shall be maintained. Time harvests to benefit the desired wildlife species.

Coordinate this practice with conservation practice standard Upland Wildlife Habitat Management (645) and accompanying job sheets.

Additional Criteria for Biomass Harvest for Energy Production

Cutting height: Harvest biomass crops at a height that will retain sufficient carbohydrate and nutrient reserves to ensure adequate stand survival and regrowth. For native warm-
season grasses the minimum stubble height should be six inches.

**CONSIDERATIONS**

When pastures produce forage in excess of livestock demand during high growth rate periods, consider preserving forage quality by machine harvesting a portion of the standing crop. Where applicable coordinate this practice with Prescribed Grazing (528).

Reseeding or interseeding may be necessary to re-establish, maintain or improve the stand. Select cultivars that are suitable for the harvest regime, species mix, and forage quality desired and are resistant to problem pests or diseases. See Forage and Biomass Planting (512).

When nutrients or other soil amendments are applied coordinate this practice with NRCS conservation practice standard for Nutrient Management (590) or Waste Utilization (633) as appropriate. An excess or improper balance of nutrients such as nitrogen can produce plant material that causes toxicity in some animals.

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.

Consider Harvesting Forages in the afternoon to optimize water soluble carbohydrates and nutritional quality.

Produce stored forages of the quality needed for optimum performance of the animal being fed. Legume forages too low in fiber can lead to metabolic disorders in ruminants and an economic loss to the producer due to lowered animal performance.

Direct-cut grass and legume silage can create silage leachate (seepage). Consider the collection, storage, and disposal of this leachate as part of an agricultural waste management system in accordance with practice standards Runoff Management System (570) and Waste Storage Facility (313).

Early cutting produces higher quality but lower quantities. Delayed harvests will usually increase yield but lower quality. This lower quality forage is still appropriate for some classes of livestock. Digestibility drops at a rate of approximately 0.5 percent per day for each day of delay in harvest beyond the early flowering stage. A forage test is the most reliable method to determine forage quality and insure that livestock nutrient needs are met. Consider lab analysis of harvested forages to determine feed quality. Coordinate this practice with NRCS practice standard Feed Management (592).

In conjunction with harvest, consider storage and feeding options that will retain forage quality and minimize digestible dry matter loss.

Rainfall and high humidity levels often cause unacceptable forage quality losses; consider use of mechanical or chemical conditioners, green-chop, or ensile the forage to reduce or eliminate field drying time.

Consider delaying harvest if prolonged or heavy precipitation is forecast that would reduce forage quality or cause soil compaction or ruts.

To reduce safety hazards, avoid operating harvesting and hauling equipment on field slopes over 25 percent, particularly across the slope. Extreme caution should be exercised when ejecting large round bales on steeper slopes as bales can roll and cause damage to structures and equipment and may cause physical injury.

Unharvested field edges, corners or odd areas provide critical nesting and brood rearing habitat within fields for a variety of wildlife.

**Additional Consideration for Biomass Harvest**

**Harvest Date.** If possible delay harvest until 30 days after the first killing frost to allow mineral nutrients to leach from the plant to the soil.

A disadvantage of delaying harvest too long is that biomass yield may decrease. The longer the crop is in the field, the greater the risk of lodging or other weather-related losses.

**Cutting Height.** Taller cutting heights will provide additional wildlife cover through the winter, as well as trap more snow.
PLANS AND SPECIFICATIONS

Place the detailed specifications in a site-specific job or design sheet or in the practice narrative in the conservation plan.

Plans and Specifications must include as a minimum for the forage harvest operations:

1. Goals, objectives, specific purpose (such as high forage quantity and quality or nutrient uptake, etc.)
2. Forage species to be harvested
   By each dominant forage species harvested show, as applicable:
3. Method of harvest
4. Stage of maturity
5. Optimal harvest moisture content
6. Length of cut
7. Stubble height to be left
8. Harvest interval including late harvest if applicable
9. Contaminant avoidance recommendations.

These plans and specifications shall be consistent with this standard and shall describe the requirement for applying the practice to achieve its intended purpose. For further guidance and crop specific specifications see Table 1.

OPERATION AND MAINTENANCE

Before forage harvest, clear fields of debris that could damage machinery or, if ingested by livestock, lead to sickness (for example, hardware disease) or death.

Operate all forage harvesting equipment at the optimum settings and speeds to minimize loss of leaves.

Set shear-plate on forage chopper to the proper cut for the crop being harvested. Keep knives well sharpened. Do not use re-cutters or screens unless forage moisture levels fall below recommended levels for optimum chopping.

Regardless of silage/haylage storage method, ensure good compaction and an airtight seal to exclude oxygen and mold formation.

Dispose of the plastic wrap or bags used to store forage in an environmentally sound manner.

REFERENCES:


USDA-NRCS National Range and Pasture Handbook, Revision 1, 2003. Grazing Lands Technology Institute, Fort Worth, TX
### Table 1
**FORAGE HARVEST GUIDE**

<table>
<thead>
<tr>
<th>Forage Species</th>
<th>Optimum Stage to Harvest</th>
<th>Approximate Date</th>
<th>Stubble Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Bud stage for 1st cutting; 1/10 bloom for second and subsequent cuttings</td>
<td>Early to mid May</td>
<td>3”</td>
</tr>
<tr>
<td>Red and Arrowleaf clovers</td>
<td>1/4 to 1/2 bloom for 1st cutting; 1/4 bloom for subsequent cuttings</td>
<td>Mid May</td>
<td>3”</td>
</tr>
<tr>
<td>Crimson clovers</td>
<td>Early bloom</td>
<td>Late April to mid May</td>
<td>3”</td>
</tr>
<tr>
<td>Annual lespedeza</td>
<td>Early bloom</td>
<td>Late July through August</td>
<td>3”</td>
</tr>
<tr>
<td>Sericea lespedeza*</td>
<td>When 12 - 15” tall</td>
<td>Mid June through August</td>
<td>4”</td>
</tr>
<tr>
<td>Birdsfoot trefoil, kura clover, and white clovers</td>
<td>1/4 bloom or at correct stage for companion grasses</td>
<td>Mid May</td>
<td>3”</td>
</tr>
<tr>
<td>Tall Fescue and Orchardgrass</td>
<td>Boot to early bloom for 1st cut; after 8” of new regrowth for subsequent cuttings</td>
<td>Mid May</td>
<td>3”</td>
</tr>
<tr>
<td>Timothy</td>
<td>Boot to early bloom for 1st cut; after 8” of new regrowth for subsequent cuttings</td>
<td>Late May to Mid June</td>
<td>3”</td>
</tr>
<tr>
<td>Perennial Ryegrass</td>
<td>12” height for 1st cut; after 8” of new regrowth for subsequent cuttings</td>
<td>Early to mid May</td>
<td>2-3”</td>
</tr>
<tr>
<td>Reed Canarygrass and Bromegrass</td>
<td>Early to mid bloom for 1st cutting; after 8” of new regrowth or when new basal buds appear at the soil surface for subsequent cuttings</td>
<td>Mid to late May</td>
<td>3-4”</td>
</tr>
<tr>
<td>Virginia Wildrye</td>
<td>Early head emergence</td>
<td>Mid to late May</td>
<td>3-4”</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>10 to 18” tall, prior to seed head formation or lower leaves starting to brown; subsequent cuttings at 4 to 5 week intervals</td>
<td>June through August</td>
<td>2-3”</td>
</tr>
<tr>
<td>Old World Bluestems</td>
<td>At or prior to boot, normally 15 to 20” tall; subsequent cuttings every 4 to 6 weeks</td>
<td>Early June through August</td>
<td>3”</td>
</tr>
<tr>
<td>Native Prairie</td>
<td>At boot, one cutting only</td>
<td>Late June to mid July</td>
<td>3-5”</td>
</tr>
</tbody>
</table>
Table 1 Continued
FORAGE HARVEST GUIDE

<table>
<thead>
<tr>
<th>Forage Species</th>
<th>Optimum Stage to Harvest</th>
<th>Approximate Date</th>
<th>Stubble Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Bluestem**</td>
<td>At boot, 24 to 30” tall</td>
<td>Early to mid July</td>
<td>3-6”</td>
</tr>
<tr>
<td>Indiangrass**</td>
<td>Prior to boot, 18 to 30” tall</td>
<td>July to early August</td>
<td>3-6”</td>
</tr>
<tr>
<td>Switchgrass**</td>
<td>At boot, 30 to 45” tall</td>
<td>Early June to late July</td>
<td>3-6”</td>
</tr>
<tr>
<td>Eastern Gamagrass</td>
<td>Prior to boot for 1st cutting; subsequent cuttings at 30 to 45 day intervals</td>
<td>Mid May to early August</td>
<td>4-6”</td>
</tr>
</tbody>
</table>

**Summer Annuals:**
- Sudangrass, sorghum-sudan hybrids, pearl millet: At 24 to 36” tall; subsequent cuttings when regrowth reaches 24” tall, Mid June through September 6-10”
- Corn - for silage: Fully dented and kernels begin to glaze, August 15 to first frost 3”
- Crabgrass: Boot to early head for 1st cutting; subsequent cuttings at 4 to 5 week intervals, Mid June through September 2-3”

**Winter Annuals:**
- Wheat, barley, rye, triticale: Boot to early dough, May 10 to June 1 2”

**Spring Annuals:**
- Oats, ryegrass: Boot to early dough, Mid May through August 2”
- Soybeans: Mid to full bloom - before bottom leaves begin to fall, July 15 through September 15 2”

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* Serecia lespedeza is very invasive; new plantings are not recommended. In most cases eradication of the species is preferred.

** One to two cuttings per year. Don’t harvest after August 10.

1 Common forage species used for mechanical harvest
2 Times suggested generally provide the optimum time to harvest for higher quality. Later harvests usually yield more forage of a lower quality.
3 Approximate time of year when forage will reach optimum harvest stage; consider seasonal differences between Northwest MO and Southeast.
4 Minimum cutting or stubble height adequate to insure plant vigor and health.
TABLE 2
SILAGE STORAGE STRUCTURE FORAGE MOISTURE SUITABILITY

<table>
<thead>
<tr>
<th>Storage Structure Type</th>
<th>Hay - crop(^1) (% moisture)</th>
<th>Corn Silage(^2) (% Moisture)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright or tower, conventional</td>
<td>60 - 65</td>
<td>63 - 68</td>
</tr>
<tr>
<td>Upright or tower, oxygen - limiting</td>
<td>40 - 55</td>
<td>55 - 60</td>
</tr>
<tr>
<td>Bunker or horizontal</td>
<td>65 - 70</td>
<td>65 - 70</td>
</tr>
<tr>
<td>Bag silo (plastic tube)</td>
<td>50 - 60</td>
<td>65 - 70</td>
</tr>
<tr>
<td>Balage (plastic wrapped round bales)</td>
<td>50 - 60</td>
<td>------</td>
</tr>
</tbody>
</table>

\(^1\) Bermudagrass should be ensiled direct cut (65 to 70\%) to get required packing.

\(^2\) Add 5 percent to the range for sorghum silage.