

USDA
NATURAL RESOURCES
CONSERVATION SERVICE
DELAWARE CONSERVATION
PRACTICE STANDARD
PASTURE AND HAY PLANTING
CODE 512
(Reported by Acre)

DEFINITION

Establishing native or introduced forage species.

PURPOSES

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

- To establish adapted and compatible plant species, varieties, or cultivars for forage production;
- To maintain or improve livestock nutrition and/or health;
- To balance forage supply and demand during periods of low forage production;
- To reduce soil erosion and improve water quality;
- To increase carbon sequestration.

**CONDITIONS WHERE PRACTICE
APPLIES**

This practice may be applied on cropland, hayland, pastureland, and other agricultural lands where forage production is feasible and desired.

This practice does not apply to:

- Plantings primarily intended for wildlife habitat, where livestock grazing and/or mechanical harvesting is a secondary consideration. Refer to the conservation practice standard for Conservation Cover (Code 327).

- Plantings that will be established on critically eroding areas that usually cannot be stabilized by ordinary conservation treatment. For site stabilization on these areas, refer to the conservation practice standard for Critical Area Planting (Code 342).
- Plantings on field edges or in riparian buffers, for which other standards are applicable. Refer to the conservation practice standards for Field Border (Code 386), Riparian Forest Buffer (Code 391), and Filter Strip (Code 393).

CONSIDERATIONS

Start planning for new plantings at least six months for grass and one year when using legumes before the planting season to allow sufficient time for soil tests, soil pH adjustment, and other site preparation that may be needed.

Consider site conditions including surrounding land uses, soils, residual herbicides (to the extent known), available moisture during the growing season, and existing vegetation on the site and in adjacent areas, including any noxious weeds that may be present.

Consider the forage needs on the farm. Select pasture and hay species to meet seasonal forage needs, the nutritional requirements of livestock, and the management techniques planned for forage harvest.

When planning mixtures, consider the relative maturity dates of plant species and varieties, their growth habits, and palatability for grazing or feeding. Select species and varieties that are expected to mature at approximately the same time. Pasture mixes should exhibit similar palatability and growth habits to minimize selective grazing.

Consider animal health issues associated with livestock consumption of some plant species. Concerns include fescue toxicosis due to alkaloid production by certain endophyte fungus infection of tall fescue, bloat associated with alfalfa and clovers, and the “slobbers” (excessive salivation) due to a fungus that primarily infects red clover

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

but may also infect other legumes.

Additional health concerns are nitrate poisoning and prussic acid (hydrogen cyanide) poisoning associated primarily with sudangrass, sorghum, and sudan-sorghum hybrids; and also with other plants, depending on environmental and management factors. Alsike clover poisoning is known to occur in horses (and occasionally in cattle), resulting in photodermatitis and long-term liver damage. For this reason, alsike clover should not be planted where pastures and hay will be used by horses.

Consider whether the planting will be used primarily for pasture (grazing) or hay (mechanically harvested). Some species are better adapted to a pasture-type management where plants are harvested at specific vegetative stages or at relatively frequent intervals. Other species and varieties benefit from a hay-type management where rest periods of 4 to 6 weeks are needed between harvests if stands and production are to be maintained.

For more intensively managed systems, consider species and varieties that are adaptable to both haying and grazing. Fields in these systems are usually hayed in late spring and grazed during the balance of the year.

To reduce the need for heavy use of pesticides, consider using cultivars that are insect and disease resistant. Plant diversity should be encouraged in order to minimize problems due to species-specific pests. Consider simple mixtures that include species that compliment one another.

Consider using cool-season species in some fields and warm-season species in others to take advantage of the entire growing season and improve the availability of forage.

Consider the need for firebreaks when warm-season grass plantings are used. Mature plantings of warm-season grasses can be quite flammable. Large areas of warm-season grasses should have cool-season grass firebreaks adjacent to woodlands and buildings, and in other locations where firebreaks may be needed to manage a prescribed burn.

If wildlife habitat is desired, consider using plant species and management techniques that will

provide food and cover for the desired wildlife species.

When water quality is a concern, consider the effects of the planting on controlling erosion and runoff and on the use and management of nutrients and pesticides.

Consider the need for additional conservation practices, such as Forage Harvest Management (Code 511), Prescribed Grazing (Code 528), Brush Management (Code 314), Nutrient Management (Code 590), and Pest Management (Code 595), as applicable.

Consider long-term maintenance requirements of the established species, including insect and disease susceptibility, fertility requirements, and special management techniques.

Take note of other constraints such as economic feasibility, available equipment, access, cost-share or program requirements, social effects, and visual aspects.

CRITERIA

General Criteria Applicable to All Purposes

Plant Selection. Select plant species to accomplish the intended purpose of the practice and the objectives of the client. Select plant species and varieties based on their adaptability to local environmental conditions, intended use, realistic yield goals, maturity stages, compatibility with other species, and level of management that the client is willing and able to provide. For best results, use species and varieties with proven conservation traits.

At a minimum, take the following factors into account when selecting the pasture and hay plantings:

1. Planned use of the planted forage (producer's goals);
2. Climatic conditions, such as annual and seasonal rainfall, growing season length, humidity, and USDA Plant Hardiness Zones (see Figure 1);
3. Soil and site conditions such as capability, drainage class, available water holding

capacity, salinity, flooding or ponding frequency, pH, and inherent fertility.

- 4. Plant characteristics, such as:
 - a. Ease of establishment, plant persistence, and time needed for full stand establishment;
 - b. Season of growth (warm or cool) and life cycle (annual, perennial, or biennial);
 - c. Suitability of the species to provide desired quality and quantity of forage;
 - d. Plant resistance to disease and insect pests common to the area;
 - e. Fertility and management requirements.

Plant materials should either be native to Delaware or introduced and non-invasive (i.e., not likely to spread beyond the planted area and displace native species). When feasible, select locally native plant species and/or species that are beneficial to wildlife.

Avoid selecting plant species that may be invasive or weedy in nearby habitats. These are species that tend to spread rapidly once established, and if not properly managed, may displace desirable vegetation in nearby areas. Reed Canarygrass and Bermudagrass shall be intensively managed by grazing, clipping, or haying to avoid seedhead maturation. The attention to management is necessary to avoid spreading seed to other fields or sensitive areas.

Use Figure 1 and Table 1 to determine the appropriate planting dates for the different types of plant materials.

Refer to the following tables to aid in selecting the appropriate plant species and seeding rates to meet the producer's needs:

Table 2 – Pasture and Hay Plantings—Annual Plantings for an Extended Grazing Season or Emergency Forage Production;

Table 3 – Warm-Season Pasture and Hay Plantings—Establishment, Management, and Use Characteristics;

Table 4 – Warm-Season Pasture and Hay Plantings—Plant Suitability for Site Conditions;

Table 5 – Warm-Season Pasture and Hay Plantings—Seeding Recommendations;

Table 6 – Cool-Season Pasture and Hay Plantings—Establishment, Management, and Use Characteristics;

Table 7 – Cool-Season Pasture and Hay Plantings—Plant Suitability for Site Conditions;

Table 8 – Cool-Season Pasture and Hay Plantings—Seeding Recommendations;

Table 9 – Selected Mixes for Cool-Season Pasture and Hay Plantings.

Cool-season grass and legume mixes are recommended as compared to cool-season grass-only stands in grazing situations. Planting intended for hay production should be made based on the expected hay market. Mixes with legumes have multiple benefits including a reduced need for nitrogen fertilizer; improved forage quality, palatability and digestibility; winter frost heaving protection for legumes; and better stand longevity and productivity. Simple mixes of one grass plus one or two legumes are easier to manage and are generally preferred.

Use of a single grass or legume species is recommended for sites with persistent weed problems that require the use of herbicides, and for sites where nutrient removal by harvest is planned.

Warm-season grasses should be seeded alone when the purpose is pasture or hay production. Indiangrass and big bluestem are the exception. They have similar maturity dates and can be planted as a mix for forage production.

Site Preparation and Soil Amendments. Site preparation to establish vegetative cover shall be done at a time and manner to insure survival and growth of selected species. Provide supplemental moisture if and when necessary to assure early survival and establishment of selected species.

Apply lime and fertilizer if needed based on soil test results. The use of commercial fertilizer and other forms of plant nutrients must be in compliance with Delaware nutrient management regulations and be applied in accordance with a written nutrient management plan.

Plant Establishment - The method of planting shall consist of techniques suited to achieving proper seeding depths, placement, and soil to seed contact for the selected plant species.

When available, certified seed shall be used for all pasture and hay plantings. All plant materials shall be correctly handled before planting. Keep seed cool and dry until planting.

Legume seeds shall be inoculated with the proper, viable *Rhizobium* bacteria before planting. Use planter box treatment or pre-inoculated seed. Check the label for the expiration date of the inoculant. Appropriate storage requirements and conditions must be observed.

Protect the planting from unacceptable impacts due to pests, wildlife, livestock, or fire. Exclude livestock as needed to establish the planting.

Control noxious weeds as required by state law.

Additional Criteria to Establish Adapted and Compatible Plant Species, Varieties, or Cultivars

Select forage species for planting based on the intended use, realistic yield goals, maturity stages, compatibility with other species, and level of management that the client is willing and able to provide. Plant adaptation to the proposed planting area shall be verified before planting.

Additional Criteria to Maintain or Improve Livestock Nutrient and/or Health

Select forage species that are capable of meeting the desired level of nutrition (quantity and quality) for the type and class of livestock to be fed.

Additional Criteria to Balance Forage Supply and Demand during Periods of Low Forage Production

Select plants that will produce forage for use during periods when other on-farm forage is insufficient to meet livestock needs.

Refer to Table 2 for recommended annual species, seeding rates, uses, and other information if an extended grazing season or emergency forage production is needed.

Additional Criteria to Reduce Soil Erosion and Improve Water Quality

Select plants that will provide adequate ground cover, canopy cover, root mass, and resistance to water flow when site conditions require erosion protection. When a pasture or hay seeding rate is expressed as a range (e.g., 5 to 10 pounds/acre), use the higher rate if erosion is a concern. As appropriate, add a nurse crop if needed to provide sufficient cover during plant establishment.

Additional Criteria to Increase Carbon Sequestration

For optimal carbon storage, select species that will increase above-ground and/or below-ground site biomass.

Note: Specific cost-sharing programs or other funding sources may dictate criteria in addition to or more restrictive than those specified in this standard.

SPECIFICATIONS

Plans and specifications for establishment of vegetative cover 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 installation of the practice. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

Follow the establishment recommendations provided in the Delaware job sheets for warm-season grasses and cool-season grasses or other applicable fact sheets and job sheets. The completed job sheet(s) can serve as the planting plan and specifications for the practice.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be prepared for each management unit. Appropriate job sheets, fact sheets, or other information sheets may be used to serve as the management plan as well as supporting documentation and shall be provided to the client. These sheets shall be referenced in the conservation plan narrative.

Pasture plantings should be managed according to the Delaware conservation practice standard for Prescribed Grazing (Code 528). Plantings that will be mechanically harvested for forage should be managed according to the Delaware conservation practice standard for Forage Harvest Management (Code 511).

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

1. Evaluate forage stands at least once each season or more frequently as needed to determine appropriate management inputs to achieve the desired purpose(s) of the planting;
2. Describe the extent of management needed to maintain the desired vegetation. Management may consist of mowing, prescribed burning, mechanical harvesting, prescribed grazing, overseeding, nutrient management, pest management, or other actions, as appropriate;
3. Control undesirable plants by mowing or spraying with a selective herbicide. To the extent feasible, "spot" spray or mow to control weeds, so that desirable plants are not destroyed unnecessarily. Noxious weeds must be controlled as required by state law;
4. Control insects and/or diseases when an infestation threatens stand survival. Follow a pest management plan concerning the timing and methods of treatment;
5. When optimum wildlife habitat is desired, do not mow, burn or mechanically harvest fields during the nesting season of the desired wildlife species. For Delaware, the primary nesting season is generally from April 15 through August 15.

Infrequent grazing may be allowed during the primary nesting season, provided the area is not grazed below 6 to 8 inches. During the establishment period, mowing may be needed during the nesting season to reduce heavy competition from annual weeds;

6. Describe the acceptable uses (e.g., grazing, haying) and time of year/frequency of use restrictions, if any.

SUPPORTING DATA AND DOCUMENTATION

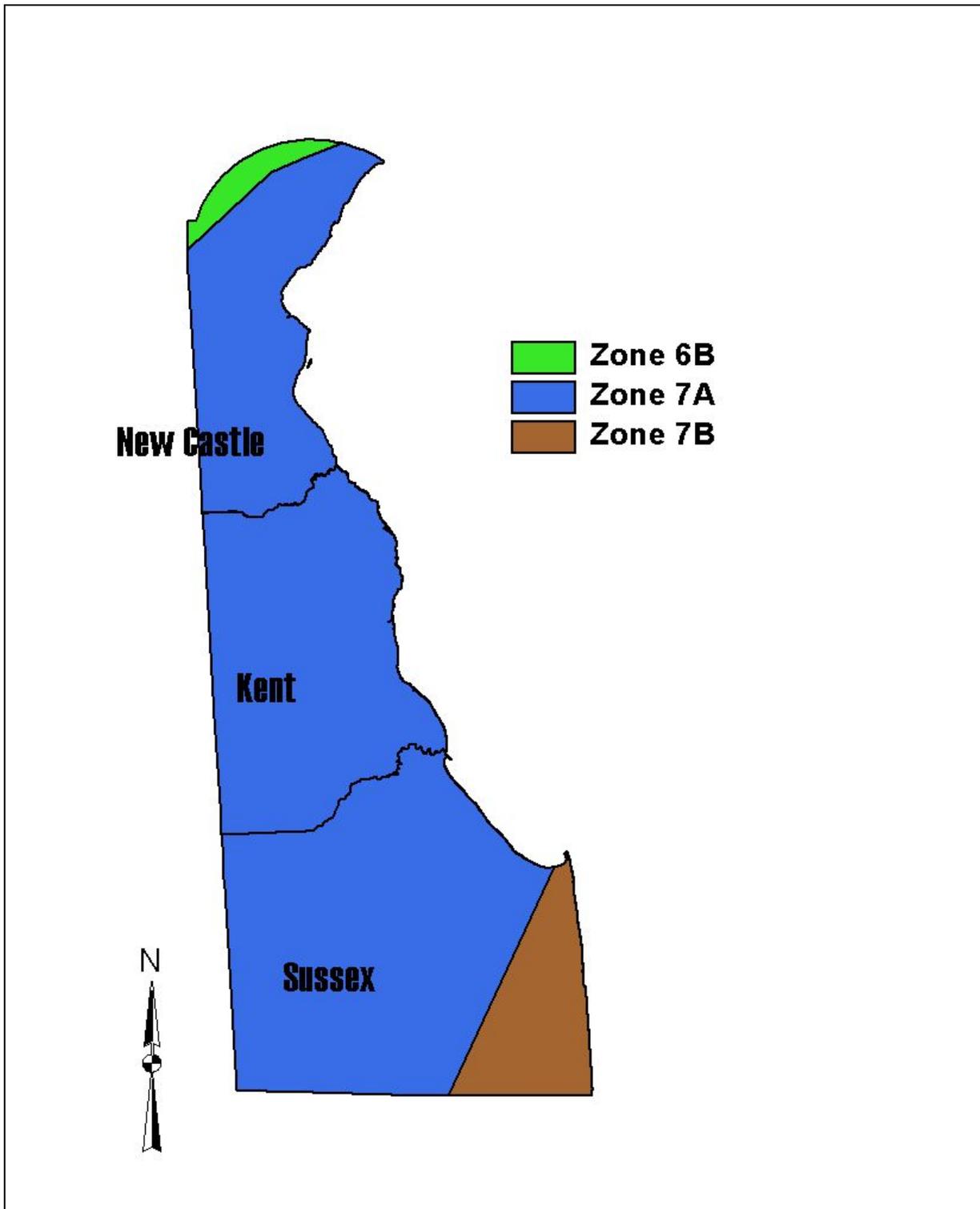
The following is a list of the minimum data and documentation to be recorded in the case file:

1. Extent of planting in acres, field number where the practice is located, and the location of the practice marked on the conservation plan map;
2. Assistance 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 copy of the appropriate job sheet(s) or other specifications, and management plans. Specify the following for each pasture or hay field or groups of fields:
 - a. Purpose of the planting;
 - b. Plant species, varieties, and seeding rates;
 - c. Planting dates.
4. Certification of seed actually planted, including species, cultivar, germination, purity, and amount planted per acre. If available, include copies of seed tags, shipping invoices, or other documents that contain this information.

REFERENCES

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2. Myers, R. David. Forage Production. Fact Sheet 470, Maryland Cooperative Extension. <http://www.agnr.umd.edu/MCS/Publications>
3. North Carolina State University, Cooperative Extension. Production and Utilization of Pastures and Forages in North Carolina. TB-305.
4. Penn State University, 2003. The Agronomy Guide. College of Agricultural Sciences. <http://AgGuide.agronomy.psu.edu/pdf.htm>
5. University of Kentucky, College of Agriculture. 2002 Cool-Season Grass Grazing Variety Report: Tolerance to Horses. PR-479.
6. University of Kentucky, Cooperative Extension Service. Forage Identification and Use Guide. AGR-175.
7. University of Maryland, Cooperative Extension. Steps to Successful No-Tillage Pasture Renovation. Agronomy Mimeo No. 96.
8. University of Maryland, Department of Agronomy. Hay and Pasture Seedings for Maryland. MEP 299.
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10. USDA, Natural Resources Conservation Service. Delaware Field Office Technical Guide, Section IV, Standards and Specifications.
11. USDA, Natural Resources Conservation Service. Maryland Wildlife Biology and Management Handbook.
12. USDA, Natural Resources Conservation Service, 1997. National Range and Pasture Handbook.
13. USDA, Natural Resources Conservation Service, and Ducks Unlimited Canada. Vegetating with Native Grasses in Northeastern North America.
14. Virginia Cooperative Extension, 2000 (reprinted). Controlled Grazing of Virginia's Pastures. Publication 418-012.

FIGURE 1: USDA Plant Hardiness Zones for Delaware



Plant Hardiness Zones delineate areas where a species can be successfully established based on average annual minimum temperatures.

TABLE 1: Recommended Planting Dates in Delaware ^{1/}		
Type of Plant Material	Plant Hardiness Zones	
	6b	7a and 7b
Seeds - Cool-Season Grasses, Legumes, and Grass-Legume Mixes***	Mar 1 to May 15 Aug 1 to Oct 15	Feb 15 to Apr 30 Aug 15 to Oct 15
Seeds - Warm-Season Grasses	Mar 1 to May 15 ♦ May 16 to Jun 15* Nov 15 to Dec 15**	Feb 15 to May 31 ♦ Jun 1 to Jun 30* Dec 15 to Dec 31**
Sprigs - Warm-Season Grasses	Mar 1 to Jun 15 ♦	Feb 15 to June 1 ♦

TABLE 1 NOTES:

1. The planting dates listed are averages for each zone. These dates may require adjustment to reflect local conditions, especially near the boundaries of the zones.

♦ In general, planting during the latter portion of this period allows more time for weed emergence and weed control prior to planting. When selecting a planting date, consider the need for weed control vs. the likelihood of having sufficient moisture for later plantings, especially on droughty sites.

* Additional planting dates during which supplemental watering may be needed to ensure plant establishment.

** Fall dormant season plantings of warm-season grasses – starting approximately 2 weeks after the first hard freeze (average date based on air temperature reading of 28 degrees F or lower, 50% probability of occurrence). Warm-season grasses need a soil temperature of at least 50 degrees F in order to germinate. If soil temperatures are colder than 50 degrees, or moisture is not adequate, the seeds will remain dormant until conditions are favorable.

Before using a fall dormant seeding, consider whether competition from winter annual weeds is likely to be a problem the following spring. Carefully planned pre-plant or post-plant herbicides should be used as appropriate. If strong competition from winter annuals is expected, it is generally preferable to use a late spring planting so that weeds can emerge and be adequately controlled before planting.

*** Certain legumes such as white/ladino and red clover can be seeded into grass fields using a frost crack seeding from January 15 to March 1. Success is dependent on receiving freeze-thaw cycles and adequate rainfall to germinate the legume seed.

TABLE 2: Pasture and Hay Plantings—Annual Plantings for an Extended Grazing Season or Emergency Forage Production^{1/}

Plant Species	Seeding Rate (lbs/ac)	Seeding Depth (inches)	Seeding Dates	Harvest Season	Time to First Harvest	Growth Stage at First Harvest		Regrowth After Grazing	Yield Range (Dry Matter)
						If Grazed	If Mechanically Harvested		
GRASSES									
Annual Ryegrass <i>Lolium perenne</i> spp. <i>multiflorum</i>	30 - 45	0.25 - 0.5	8/15 - 10/15	Fall, spring, early summer	30 - 45 days	At 6 inches	At 15 - 20 inches	Yes	2 - 5 tons
Barley <i>Hordeum vulgare</i>	100 - 150	1.0 - 1.5	9/1 - 10/1	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot – early head	Yes	1 - 2 tons
Cereal Rye <i>Secale cereale</i>	120 - 180	1.0 - 1.5	8/15 - 11/15	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot – early head	Yes	2 - 3 tons
Corn <i>Zea mays</i>	25,000 - 45,000 seeds/acre	1.0 - 2.5	4/15 - 6/1	Summer	40 - 100 days	Above 20 inches	Milk line 1/3 - 1/2 down kernel	No	3 - 8 tons
Oats <i>Avena sativa</i>	100 - 150	1.0 - 1.5	3/1 - 4/15, 8/1 - 8/30	Spring, early summer, fall	35 - 50 days	Vegetative stage, at 3 - 5 inches	Late boot - head	Yes	2 - 4 tons
Pearl Millet <i>Pennisetum glaucum</i>	25 - 30	0.5 - 1.5	5/1 - 8/1	Summer	30 - 45 days	At 18 inches	Above 18 inches, early head - early bloom	Yes	3 - 5 tons
Sudangrass Sudan x Sorghum <i>Sorghum bicolor</i>	20 - 30	.5 - 1.5	5/10 - 7/15	Summer	30 - 45 days	Minimum of 18 inches, wait 7 days after frost	At 36 - 48 inches, early head - early bloom	Yes	3 - 8 tons
Triticale <i>Triticale hexaploide</i>	120 - 180	1.0 - 1.5	8/15 - 11/15	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot - head	Yes	1 - 3 tons
Wheat <i>Triticum aestivum</i>	120 - 180	1.0 - 1.5	10/1 - 10/15	Fall, spring	40 - 60 days	Vegetative stage, at 3 - 5 inches	Late boot - head	Yes	1 - 2 tons
BRASSICAS									
Kale <i>Brassica oleracea</i>	3 - 4	0.25 - 0.5	5/1 - 6/15	Late summer, fall	120 - 180 days	150 days after seeding	----	No	1 - 5 tons
Rape <i>Brassica napus</i>	3 - 4	0.25 - 0.5	5/1 - 8/15	Summer, fall	80 - 90 days	80 - 90 days after establishment	----	Yes	1 - 5 tons
Swede <i>Brassica napus</i>	1 - 2	0.25 - 0.5	5/1 - 6/15	Fall	150 - 180 days	150 days after seeding	----	No	1 - 5 tons
Turnips <i>Brassica rapa</i>	2	0.25 - 0.5	5/1 - 8/15	Summer, fall	60 - 90 days	70 - 90 days after establishment	----	Yes	1 - 5 tons

TABLE 2 NOTE:

1. Animal Health Concerns: Caution--Livestock consumption of sorghum, sudangrass, and sudan-sorghum hybrids (and to some extent, other plants) can result in nitrate poisoning and prussic acid (hydrogen cyanide) poisoning. Plant growth stage, plus environmental and management factors, affect nitrate and prussic acid concentrations in foliage. To minimize health risks to livestock, use careful management when feeding with emergency and late-season forages, and know when to expect potential problems and how to avoid them. Before feeding any suspect forage, have representative samples tested for nitrate and prussic acid content.

TABLE 3: Warm-Season Pasture and Hay Plantings—Establishment, Management, and Use Characteristics

Species	Seedling Growth Rate ^{1/}	Plant Growth Habit	Stand Persistence ^{2/}	Forage Quality ^{3/}		Relative Maturity ^{4/}	Suitability for Grazing Management ^{5/}		Suitability for Mechanical Harvest ^{6/}	
				Palatability	Digestibility		Rotational Grazing	Continuous Grazing	Hay	Silage
Bermudagrass ^{7/} <i>Cynodon dactylon</i>	Moderate	Sod	Moderate - Long	High	Moderate	Late	Good to Very Good	Good	Good	Good
Big Bluestem <i>Andropogon gerardii</i>	Slow	Bunch	Long	High	High	Very Late	Good	Poor	Good	Poor
Caucasian Bluestem <i>Bothriochloa bladhii</i> (<i>B. caucasica</i>)	Slow	Bunch	Long	High	High	Late	Good	Poor	Good	Poor
Eastern Gamagrass <i>Tripsacum dactyloides</i>	Slow	Bunch	Long	Very High	High	Very Late	Good to Very Good	Poor	Good	Good
Indiangrass <i>Sorghastrum nutans</i>	Slow	Bunch	Long	High	Moderate	Very Late	Fair to Good	Poor	Good	Poor
Little Bluestem <i>Schizachyrium scoparium</i>	Slow	Bunch	Long	Moderate	Moderate	Very Late	Fair	Poor	Poor	Poor
Switchgrass <i>Panicum virgatum</i>	Slow	Bunch	Long	Moderate	High	Very Late	Fair to Good	Poor	Good	Poor

NOTES FOR TABLES 3:

- Seedling Growth Rate (Slow, Moderate, Fast): Vigor and competitiveness of the species, as compared to other grasses or legumes. Slow-growing seedlings tend to have more problems with weed competition than faster growing species.
- Stand Persistence (Short, Moderate, Long): Persistence of the species (without replanting) as compared to other grasses or legumes. This is an indication of how soon the planting will need to be renovated or overseeded. Long - Generally 5 years or more; Moderate - 3 to 5 years; Short - 1 or 2 years.
- Forage Quality (Low, Moderate, High): Values of each species for palatability and digestibility, as compared to other forages. When developing pasture mixes, select species that have similar palatability to minimize selective grazing.
- Relative Maturity (Early, Medium, Late, Very Late): Relative time of maturity for each species during the growing season. When developing pasture or hay mixes, select species and varieties that are expected to mature at approximately the same time.
- Suitability for Grazing Management (Poor, Fair, Good, Excellent): Describes the suitability of each species for grazing, depending on the type of grazing system used. Rotational Grazing – A system that provides a rest and regrowth period for pastures. Continuous Grazing – A system that allows livestock to have continuous access to pastures.
- Suitability for Mechanical Harvest (Poor, Fair, Good, Excellent): Describes the suitability of each species as a mechanically harvested forage crop, depending on whether the forage will be harvested and stored as hay or as silage.
- Bermudagrass: Caution—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**

TABLE 4: Warm-Season Pasture and Hay Plantings—Plant Suitability for Site Conditions

Plant Species	Plant Hardiness Zones ^{1/}	Soil Drainage Class ^{2/}	Soil pH ^{3/}	Fertility Requirements ^{4/}	Flooding or Ponding Tolerance ^{5/}	Drought Tolerance ^{6/}	Salinity Tolerance ^{7/}	Winter Hardiness ^{8/}
Bermudagrass ^{9/} <i>Cynodon dactylon</i>	7a, 7b	E - SP	5.0 - 7.5	Moderate - High	Moderate	High	Moderate	Poor
Big Bluestem <i>Andropogon gerardii</i>	All	E - MW	5.0 - 7.5	Low - Moderate	Low	Very High	Low	Good
Caucasian Bluestem <i>Bothriochloa bladhii</i> (<i>B. caucasica</i>)	All	E - MW	5.0 - 8.0	Moderate	None	High	Low	Good
Eastern Gamagrass <i>Tripsacum dactyloides</i>	All	W - P	5.0 - 7.5	Moderate - High	Moderate	High	None	Good
Indiangrass <i>Sorghastrum nutans</i>	All	E - MW	5.0 - 7.5	Low - Moderate	None	Very High	Moderate	Good
Little Bluestem <i>Schizachyrium scoparium</i>	All	E - MW	5.5 - 8.5	Low - Moderate	None	Very High	None	Good
Switchgrass <i>Panicum virgatum</i>	All	E - P	4.5 - 7.5	Low - Moderate	Low - High (depends on the variety)	Low - Very High (depends on the variety)	Moderate	Good

TABLE 4 NOTES:

1. The Plant Hardiness Zones designate where a species can be successfully grown in Delaware, as shown on the Plant Hardiness Zone map (Figure 1).
2. Soil Drainage Class (refer to the county soil survey for further information):
E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.
3. Soil pH: Preferred soil pH range for fair to excellent forage production.
4. Fertility Requirements (Low, Moderate, High): Indicates the relative need of each species for nutrients to support plant growth. Species with relatively high fertility requirements will require more frequent nutrient applications.
5. Flooding or Ponding Tolerance (None, Low, Moderate, High): Describes the ability of each species to tolerate anaerobic conditions associated with extended ponding or flooding (generally more than 24 hours, continuously).
6. Drought Tolerance (Low, Moderate, High): Describes the ability of each species to withstand long periods of hot, dry weather. For each plant species, some varieties may be more (or less) tolerant than others.
7. Salinity Tolerance (None, Low, Moderate, High): Describes the ability of each species to withstand and flourish in saline soils (i.e., soils that contain water-soluble salts. For each plant species, some varieties may be more (or less) tolerant than others.
8. Winter Hardiness (Poor, Fair, Good, Excellent): Describes the ability of each species to survive typical winters in Delaware. For each plant species, some varieties may be more (or less) winter hardy than others.
9. Bermudagrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**

TABLE 5: Warm-Season Pasture and Hay Plantings—Seeding Recommendations

Plant Species	Recommended Cultivar(s)	Seeding Rate (PLS lbs/ac) ^{1/}	Seeding Depth (inches)	Planting Implement
Bermudagrass ^{2/} <i>Cynodon dactylon</i>	Midland, Quickstand, Tifton 44, World Feeder	20 bushels/acre, sprigged	N/A	Sprigger
Big Bluestem <i>Andropogon gerardii</i>	Niagara	8 - 10	0.25 - 0.5	Warm-Season Grass Drill
Caucasian Bluestem <i>Bothriochloa bladhii</i> (<i>B. caucasica</i>)	Common	6 - 8	0.25 - 0.5	Warm-Season Grass Drill
Eastern Gamagrass ^{3/} <i>Tripsacum dactyloides</i>	Iuka, Pete, PMK-24	10	0.75 - 1.0	Corn Planter
Indiangrass <i>Sorghastrum nutans</i>	Rumsey	8 - 10	0.25 - 0.5	Warm-Season Grass Drill
Little Bluestem <i>Schizachyrium scoparium</i>	Blaze, Camper	7	0.25 - 0.5	Warm-Season Grass Drill
Switchgrass <i>Panicum virgatum</i>	<u>Lowland Ecotypes:</u> Cave-in-Rock, Kanlow <u>Upland Ecotypes:</u> Blackwell, Carthage	8 - 10	0.25 - 0.5	Conventional Grass Drill or Broadcast and Cultipack

TABLE 5 NOTES:

- Seeding Rate:** Seeding rates for the warm-season grasses are in pounds of Pure Live Seed (PLS). Actual planting rates shall be adjusted to reflect percent seed germination and purity, as tested. Adjustments are usually not needed for the cool-season grasses or legumes. Whenever possible, optimize seed distribution by using a brillion or cultipacker-seeder. If drilling, it is recommended to split rates and apply seed twice, with the second pass going perpendicular across the first drill rows. Chaffy warm season seeds will require a specialized seed drill or native grass drill.
- Bermudagrass: Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**
- For **Eastern Gamagrass**, recommend using dry, stable seed that is pre-treated to break dormancy.

TABLE 6: Cool-Season Pasture and Hay Plantings—Establishment, Management, and Use Characteristics

Species	Seedling Growth Rate ^{1/}	Plant Growth Habit	Stand Persistence ^{2/}	Forage Quality ^{3/}		Relative Maturity ^{4/}	Suitability for Grazing Management ^{5/}		Suitability for Mechanical Harvest ^{6/}		Compatible Species for Mixtures ^{7/}
				Palatability	Digestibility		Rotational Grazing	Continuous Grazing	Hay	Silage	
GRASSES											
Kentucky Bluegrass <i>Poa pratensis</i>	Moderate	Sod	Long	High	Moderate	Early	Excellent	Excellent	Poor	Poor	Timothy Birdsfoot Trefoil Ladino Clover
Orchardgrass <i>Dactylis glomerata</i>	Fast	Bunch	Moderate	Moderate	Moderate	Early	Excellent	Good	Excellent	Excellent	Alfalfa Birdsfoot Trefoil Ladino Clover Red Clover
Perennial Ryegrass ^{8/} <i>Lolium perenne</i> Diploid and Tetraploid types	Very Fast	Bunch	Short	High	High	Early	Excellent	Poor	Good	Excellent	Alfalfa Birdsfoot Trefoil Ladino Clover Red Clover
Prairiegrass ^{8/} <i>Bromus catharticus</i>	Fast	Bunch	Short	High	High	Late	Good	Poor	Excellent	Excellent	Alfalfa
Reed Canarygrass ^{11/} <i>Phalaris arundinacea</i>	Slow	Sod	Long	High	High Low- Alkaloid Varieties	Early	High	Poor	Good	Good	Alfalfa Redclover Birdsfoot Trefoil
Smooth Bromegrass ^{8/} <i>Bromus inermis</i>	Moderate	Sod	Short	High	Moderate	Late	Good	Poor	Excellent	Excellent	Alfalfa Birdsfoot Trefoil Ladino Clover
Tall Fescue ^{9/} (endophyte-free or novel endophyte) <i>Lolium arundinaceum</i> (formerly <i>Festuca arundinacea</i>)	Moderate	Bunch	Moderate	Moderate	Moderate	Medium	Excellent	Poor	Excellent	Good	Alfalfa Ladino Clover Red Clover

TABLE 6: Cool-Season Pasture and Hay Plantings—Establishment, Management, and Use Characteristics

Species	Seedling Growth Rate ^{1/}	Plant Growth Habit	Stand Persistence ^{2/}	Forage Quality ^{3/}		Relative Maturity ^{4/}	Suitability for Grazing Management ^{5/}		Suitability for Mechanical Harvest ^{6/}		Compatible Species for Mixtures ^{7/}
				Palatability	Digestibility		Rotational Grazing	Continuous Grazing	Hay	Silage	
Timothy <i>Phleum pratense</i>	Slow	Bunch	Short	Moderate	Moderate	Late	Good	Poor	Excellent	Excellent	Ky. Bluegrass Alfalfa Birdsfoot Trefoil Ladino Clover Red Clover
LEGUMES											
Alfalfa ^{10/} <i>Medicago sativa</i>	Fast	Bunch	Long	High	High	Early	Excellent	Poor	Excellent	Excellent	Orchardgrass Perennial Ryegrass Smooth Bromegrass Tall Fescue Timothy.
Annual Lespedeza: Korean <i>Kummerowia stipulacea</i> or Common <i>K. striata</i> (both species formerly in genus <i>Lespedeza</i>)	Moderate	Spreading	Moderate	Moderate	High	Medium	Excellent	Poor	Good	Poor	Orchardgrass Tall Fescue Timothy Red Clover
Birdsfoot Trefoil <i>Lotus corniculatus</i>	Slow	Bunch	Long	High	High	Late	Good	Good	Good	Good	Ky. Bluegrass, Orchardgrass, Perennial Ryegrass Smooth Bromegrass Tall Fescue, Timothy.
Ladino Clover ^{10/} <i>Trifolium repens</i>	Moderate	Spreading	Moderate	High	High	Early	Excellent	Good	Good	Good	Ky. Bluegrass Orchardgrass Perennial Ryegrass Smooth Bromegrass Tall Fescue, Timothy Red Clover.
Red Clover ^{10/} <i>Trifolium pratense</i>	Fast	Bunch	Short	Moderate	High	Medium	Good	Poor	Good	Good	Orchardgrass, Perennial Ryegrass Tall Fescue, Timothy Ladino Clover

Notes for this table are located on page 15.

TABLE 6 NOTES:

1. Seedling Growth Rate (Slow, Moderate, Fast): Vigor and competitiveness of the species, as compared to other grasses or legumes. Slow-growing seedlings tend to have more problems with weed competition than faster growing species.
2. Stand Persistence (Short, Moderate, Long): Persistence of the species (without replanting) as compared to other grasses or legumes. This is an indication of how soon the planting will need to be renovated or overseeded. Long - Generally 5 years or more; Moderate - 3 to 5 years; Short - 1 or 2 years.
3. Forage Quality (Low, Moderate, High): Values of each species for palatability and digestibility, as compared to other forages. When developing pasture mixes, select species that have similar palatability to minimize selective grazing.
4. Relative Maturity (Early, Medium, Late, Very Late): Relative time of maturity for each species during the growing season. When developing pasture or hay mixes, select species and varieties that are expected to mature at approximately the same time.
5. Suitability for Grazing Management (Poor, Fair, Good, Excellent): Describes the suitability of each species for grazing, depending on the type of grazing system used. Rotational Grazing – A system that provides a rest and regrowth period for pastures. Continuous Grazing – A system that allows livestock to have continuous access to pastures.
6. Suitability for Mechanical Harvest (Poor, Fair, Good, Excellent): Describes the suitability of each species as a mechanically harvested forage crop, depending on whether the forage will be harvested and stored as hay or as silage.
7. Compatible Species for Mixtures: If desired, one or more of these species may be combined with the primary species to make a mixture. When making mixtures, select species that are suited for the geographic location (plant hardiness zone) and local site characteristics and have the desired plant characteristics for establishment, maintenance, and use of the forage. Simple mixtures, such as one species of grass and one or two legumes, are generally recommended versus a mix with many species.
8. Perennial Ryegrass, Prairiegrass, and Smooth Brome: In Delaware, stand persistence is significantly reduced for these species due to disease and climate factors.
9. Tall Fescue Varieties: To avoid fescue toxicosis, use certified varieties that are endophyte-free or are novel endophyte-infected. Fescue with the novel endophyte is not toxic to livestock, and has the adaptive advantages of being more resistant to drought, disease, and insects than endophyte-free varieties. Certified varieties of endophyte-infected tall fescue (such as Kentucky-31) may be used for stockpile grazing (i.e., winter grazing) when the risk of endophyte toxicity is much reduced. Consult the manufacturer concerning suitability for horses and brood mares.
10. Animal Health Issues Associated with Legumes: **Caution**--Livestock consumption of some legume species may result in adverse health effects. To minimize health risks to livestock, use careful management with these species, and know when to expect potential problems and how to avoid them. The following health concerns have been associated with specific legumes:
 - Bloat** - Associated with consumption of alfalfa, various clovers, cowpeas, and other legumes (but not birdsfoot trefoil);
 - Alsike Clover Poisoning** - Associated with consumption of alsike clover. This type of poisoning is known to occur in horses and occasionally in cattle, resulting in photodermatitis and long-term liver damage. Alsike clover should not be planted where pastures and hay will be used by horses;
 - "Slobbers" (Excessive Salivation)** - Associated with consumption of fungal-infected red clover (and sometimes white clover and other legumes) by horses and cattle.
11. Reed Canarygrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**

TABLE 7: Cool-Season Pasture and Hay Plantings—Plant Suitability for Site Conditions

Plant Species	Plant Hardiness Zones ^{1/}	Soil Drainage Class ^{2/}	Soil pH ^{3/}	Fertility Requirements ^{4/}	Flooding or Ponding Tolerance ^{5/}	Drought Tolerance ^{6/}	Salinity Tolerance ^{7/}	Winter Hardiness ^{8/}
GRASSES								
Kentucky Bluegrass <i>Poa pratensis</i>	All	W - SP	5.5 - 7.0	Moderate	Low	Low	Low	Good
Orchardgrass <i>Dactylis glomerata</i>	All	E - SP	5.5 - 7.0	Moderate	None	Moderate	Low	Good
Perennial Ryegrass <i>Lolium perenne</i>	All	W - P	5.0 - 8.0	Moderate-High	Low	Low	Low	Poor-Fair
Prairiegrass <i>Bromus catharticus</i>	All	E - MW	5.5 - 8.0	Moderate-High	None	Low	Moderate	Fair
Reed Canarygrass ^{9/} <i>Phalaris arundinacea</i>	All	W - P	5.0 - 7.0	Moderate-High	Moderate	High	Moderate	Good
Smooth Bromegrass <i>Bromus inermis</i>	5b, 6a, 6b	E - P	5.5 - 8.0	High	Low	Moderate	Low	Fair
Tall Fescue (endophyte-free or novel endophyte) <i>Lolium arundinaceum</i> (formerly <i>Festuca arundinacea</i>)	All	E - P	4.5 - 9.0	Moderate	Low	Moderate	Moderate	Good
Timothy <i>Phleum pratense</i>	5b, 6a, 6b	W - SP	5.0 - 7.5	Moderate	Low	Low	Low	Good
LEGUMES								
Alfalfa <i>Medicago sativa</i>	All	E - W	6.5 - 7.0	High	None	High	Low	Excellent
Annual Lespedeza: Korean <i>K. stipulacea</i> or Common <i>K. striata</i> (both species formerly in genus <i>Lespedeza</i>)	All	E - P	4.5 - 7.0	Low - Moderate	Low	High	Low	None (Annual)
Birdsfoot Trefoil <i>Lotus corniculatus</i>	5b, 6a, 6b	W - P	5.0 - 7.5	Moderate	Moderate	Moderate	Moderate	Excellent
Ladino Clover <i>Trifolium repens</i>	All	W - P	5.5 - 7.5	Moderate-High	Moderate	Low	Low	Good

TABLE 7: Cool-Season Pasture and Hay Plantings—Plant Suitability for Site Conditions

Plant Species	Plant Hardiness Zones ^{1/}	Soil Drainage Class ^{2/}	Soil pH ^{3/}	Fertility Requirements ^{4/}	Flooding or Ponding Tolerance ^{5/}	Drought Tolerance ^{6/}	Salinity Tolerance ^{7/}	Winter Hardiness ^{8/}
Red Clover <i>Trifolium pratense</i>	All	W - SP	6.0 - 7.5	Moderate	None	Low	Low	Good

TABLES 7 NOTES:

1. The Plant Hardiness Zones designate where a species can be successfully grown in Delaware, as shown on the Plant Hardiness Zone map (Figure 1).
2. Soil Drainage Class (refer to the county soil survey for further information):
E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.
3. Soil pH: Preferred soil pH range for fair to excellent forage production.
4. Fertility Requirements (Low, Moderate, High): Indicates the relative need of each species for nutrients to support plant growth. Species with relatively high fertility requirements will require more frequent nutrient applications.
5. Flooding or Ponding Tolerance (None, Low, Moderate, High): Describes the ability of each species to tolerate anaerobic conditions associated with extended ponding or flooding (generally more than 24 hours, continuously).
6. Drought Tolerance (Low, Moderate, High): Describes the ability of each species to withstand long periods of hot, dry weather. For each plant species, some varieties may be more (or less) tolerant than others.
7. Salinity Tolerance (None, Low, Moderate, High): Describes the ability of each species to withstand and flourish in saline soils (i.e., soils that contain water-soluble salts. For each plant species, some varieties may be more (or less) tolerant than others.
8. Winter Hardiness (Poor, Fair, Good, Excellent): Describes the ability of each species to survive typical winters in Delaware. For each plant species, some varieties may be more (or less) winter hardy than others.
9. Reed Canarygrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**

TABLE 8: Cool-Season Pasture and Hay Plantings—Seeding Recommendations

Plant Species	Recommended Cultivar(s)	Seeding Rate (lbs/ac)			Seeding Depth (inches)	Suitability for Frost Seeding ^{1/}
		Alone	Pasture Mix	Hay Mix		
GRASSES						
Kentucky Bluegrass <i>Poa pratensis</i>	Ginger, Ken Blue, Park, Slezanka, Troy	15	5 - 15	----	<0.25	Poor
Orchardgrass <i>Dactylis glomerata</i>	Baraula, Benchmark, Cambria, Potomac	10 - 15	5 - 15	2 - 5	0.25 - 0.5	Poor
Perennial Ryegrass <i>Lolium perenne</i>	BG-14, BG-23, BG-34, Mara	30	10 - 15	4 - 8	0.25 - 0.5	Good
Prairiegrass <i>Bromus catharticus</i>	Matua	25 - 40	----	20 - 30	0.25 - 0.5	Poor
Reed Canarygrass ^{2/} <i>Phalaris arundinacea</i>	Palaton, Venture	14	6 - 8	6 - 8	0.25 - 0.25	Poor
Smooth Bromegrass <i>Bromus inermis</i>	Baylor, Saratoga	15	4 - 15	6 - 10	0.25 - 0.5	Poor
Tall Fescue (endophyte-free or novel endophyte) <i>Lolium arundinaceum</i> (formerly <i>Festuca arundinacea</i>)	<u>Endophyte-free</u> : Barcarella, Barcel, Bariano, Barolex, Cattle Club, Dovey, Stargrazer <u>Novel endophyte</u> : MaxQ <u>Endophyte-infected</u> (for stockpile grazing only): KY-31	15 - 35	10 - 15	5 - 10	0.25	Poor
Timothy <i>Phleum pratense</i>	<u>Early maturity</u> : Mariposa, Richmond, Toro <u>Medium maturity</u> : Climax, Mohawk <u>Late maturity</u> : Champlain	10 - 15	4 - 10	2 - 6	<0.5	Poor
LEGUMES						
Alfalfa <i>Medicago sativa</i>	Any leafhopper-resistant variety	15 - 20	10 - 15	10 - 15	0.25 - 0.5	Poor
Annual Lespedeza: Korean <i>K. stipulacea</i> or Common <i>K. striata</i> (both species formerly in genus <i>Lespedeza</i>)	<u>Korean</u> : Climax or Rowan <u>Common</u> : Kobe	15 - 25	10 - 15	10 - 15	0.25 - 0.5	Good
Birdsfoot Trefoil <i>Lotus corniculatus</i>	<u>Pasture</u> : Dawn, Empire <u>Hay</u> : Fergus, Norcen, Tretana, Viking	10	6 - 10	2 - 6	<0.25	Good
Ladino Clover <i>Trifolium repens</i>	Alice (a tall variety), Durana, Regal, Patriot	----	1 - 3	1 - 3	0.25	Excellent
Red Clover <i>Trifolium pratense</i>	Any northern or southern anthracnose-resistant variety	10 - 15	4 - 8	4 - 8	0.25	Excellent

1. Suitability for Frost Seeding (Poor, Fair, Good, Excellent): Describes the suitability of each species for broadcast-overseeding during late winter to reestablish it in an established stand.

2. Reed Canarygrass: **Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**

TABLE 9: Selected Mixes for Cool-Season Pasture and Hay Plantings ^{1/}

Mix	Seeding Rate ^{2/} (lbs/ac)		Plant Hardiness Zones ^{3/}	Soil Drainage Class ^{4/}	Recommended Use	Remarks
	Pasture	Hay				
Grass-Alfalfa Mixes						
1. SELECT ONE GRASS: Orchardgrass <i>Dactylis glomerata</i> Perennial Ryegrass <i>Lolium perenne</i> Tall Fescue <i>Lolium arundinaceum</i> Reed Canarygrass ^{5/} <i>Phalaris arundinacea</i> AND ADD: Alfalfa <i>Medicago sativa</i>	10 - 15	2 - 5	All	W - MW	Pasture or Hay	Use a novel endophyte-infected variety of Tall Fescue. Perennial Ryegrass is useful for quick reseeding - high quality pasture, but is short-lived.
	10 - 15	4 - 8				
	10 - 15	5 - 10				
	6 - 8	6 - 8				
	10 - 15	10 - 15				
2. SELECT ONE GRASS: Perennial Ryegrass <i>Lolium perenne</i> Smooth Bromegrass <i>Bromus inermis</i> Timothy <i>Phleum pratense</i> AND ADD: Alfalfa <i>Medicago sativa</i>	10 - 15	4 - 8	6b	W - MW	Pasture or Hay	Perennial Ryegrass is useful for quick reseeding – high quality pasture, but is short lived. Smooth Bromegrass and Timothy are suitable for one-cut hay and less intensive pasturing, as compared to Mix 1.
	8 - 15	6 - 10				
	5 - 10	2 - 6				
	10 - 15	10 - 15				
Grass-Birdsfoot Trefoil Mixes						
3. SELECT ONE GRASS: Orchardgrass <i>Dactylis glomerata</i> Smooth Bromegrass <i>Bromus inermis</i> Timothy <i>Phleum pratense</i> Reed Canarygrass ^{5/} <i>Phalaris srundinacea</i> AND ADD: Birdsfoot Trefoil <i>Lotus corniculatus</i>	10 - 15	2 - 5	6b	W - P	Pasture or Hay	Good for wet sites. "No bloat" mix.
	8 - 15	6 - 10				
	5 - 10	2 - 6				
	6 - 8	6 - 8				
	6 - 10	2 - 6				
4. USE TWO GRASSES: Kentucky Bluegrass <i>Poa pratensis</i> Timothy <i>Phleum pratense</i> AND ADD: Birdsfoot Trefoil <i>Lotus corniculatus</i>	5 - 15		6b	W - SP	Pasture	"No bloat" mix.
	5 - 10	N/A				
	6 - 10					
Grass-Clover Mixes						

TABLE 9: Selected Mixes for Cool-Season Pasture and Hay Plantings ^{1/}

Mix	Seeding Rate ^{2/} (lbs/ac)		Plant Hardiness Zones ^{3/}	Soil Drainage Class ^{4/}	Recommended Use	Remarks
	Pasture	Hay				
5. SELECT ONE GRASS: Orchardgrass <i>Dactylis glomerata</i> Perennial Ryegrass <i>Lolium perenne</i> AND ADD: Ladino Clover <i>Trifolium repens</i> Red Clover <i>Trifolium pratense</i>	10 - 15 10 - 15 1 - 2 2 - 4	N/A	All	W - SP	Pasture	Red clover produces an alkaloid that can cause horses to slobber or drool excessively. When used in horse pastures, plant the red clover at 50% of the specified rate if "the slobbers" is a concern or use Mix 10 instead.
Grass-Clover Mixes (Cont'd.)						
6. SELECT ONE GRASS: Perennial Ryegrass <i>Lolium perenne</i> Smooth Bromegrass <i>Bromus inermis</i> Timothy <i>Phleum pratense</i> AND ADD: Ladino Clover <i>Trifolium repens</i> Red Clover <i>Trifolium pratense</i>	10 - 15 8 - 15 5 - 10 1 - 2 2 - 4	N/A	6b	W - SP	Pasture	For Red Clover in horse pastures, see Remarks for Mix 5. Ladino/white clover – intolerant of droughty soils Timothy – sensitive to high temperatures Red Clover – short-lived, low winter hardiness
7. USE ALL THREE GRASSES: Kentucky Bluegrass <i>Poa pratensis</i> Perennial Ryegrass <i>Lolium perenne</i> Timothy <i>Phleum pratense</i> AND ADD: Ladino Clover <i>Trifolium repens</i> Red Clover <i>Trifolium pratense</i>	5 - 15 5 - 10 5 - 10 1 - 2 2 - 4	N/A	6b	W - SP	Pasture	Tall Fescue or novel endophyte-infected variety) can be substituted for Perennial Ryegrass or Timothy. For Red Clover in horse pastures, see Remarks for Mix 5. Red Clover – short-lived, low winter hardiness Timothy – sensitive to high temperatures Perennial Ryegrass – Sensitive to drought
8. SELECT ONE GRASS: Orchardgrass <i>Dactylis glomerata</i> Perennial Ryegrass <i>Lolium perenne</i> Reed Canarygrass ^{5/} <i>P.arundinacea</i> Tall Fescue <i>Lolium arundinaceum</i> Timothy <i>Phleum pratense</i> AND ADD: Red Clover <i>Trifolium pratense</i>	10 - 15 10 - 15 6 - 8 15 - 20 10 - 12 4 - 8	2 - 5 4 - 8 6 - 8 5 - 10 2 - 6 4 - 8	All (see Remarks)	W - SP	Pasture or Hay	Use an endophyte-free or novel endophyte-infected variety of Tall Fescue. Timothy is best suited for PHZ 6b. For Red Clover in horse pastures, see Remarks for Mix 5. Perennial Ryegrass - Sensitive to drought

TABLE 9: Selected Mixes for Cool-Season Pasture and Hay Plantings ^{1/}

Mix	Seeding Rate ^{2/} (lbs/ac)		Plant Hardiness Zones ^{3/}	Soil Drainage Class ^{4/}	Recommended Use	Remarks
	Pasture	Hay				
9. SELECT ONE GRASS: Orchardgrass <i>Dactylis glomerata</i> Tall Fescue <i>Lolium arundinaceum</i> AND ADD: Korean Lespedeza <i>K. stipulacea</i> Red Clover <i>Trifolium pratense</i>	5 - 10 5 - 12 10 - 15 4 - 8	N/A	All	W - SP	Pasture	Use a novel endophyte-infected variety of Tall Fescue. The Lespedeza component makes this an especially good mix for PHZ 7a and 7b. Lespedeza is more heat-tolerant than most of the other legumes.
Grass Mixes without Legumes						
10. USE ALL THREE GRASSES: Kentucky Bluegrass <i>Poa pratensis</i> Smooth Bromegrass <i>Bromus inermis</i> Timothy <i>Phleum pretense</i>	5 - 15 4 - 8 4 - 8	N/A	6b	W - SP	Pasture	Good grass base for pastures; especially suited for horse pastures.
11. USE TWO GRASSES: Kentucky Bluegrass <i>Poa pratensis</i> Tall Fescue <i>Lolium arundinaceum</i>	5 - 10 20 - 25	N/A	All	W - SP	Pasture	For heavily grazed horse pastures or other loafing lots, use this mix with a novel endophyte variety of Tall Fescue. It will withstand abuse better than the endophyte-free varieties. Follow the Tall Fescue manufacturer's guidelines for establishment.

NOTES FOR TABLE 9:

- Selected Mixes:** These mixes have been selected based primarily on recommendations in the Penn State Agronomy Guide and fact sheets from Maryland Cooperative Extension. Due to page limitations, this list of mixes is not all-inclusive. There are many other combinations of grasses and/or legumes that may be suitable for pasture or hay, depending on site conditions and the producer's needs. All legume seeds shall be inoculated before planting with the appropriate *Rhizobium* bacteria.
- Seeding Rates:** Whenever possible, optimize seed distribution by using a brillion or cultipacker-seeder. If drilling, it is recommended to split rates and apply seed twice, with the second pass going perpendicular across the first drill rows. If broadcast planting, increase the seeding rate by 50%.
- The Plant Hardiness Zones** designate where a species can be successfully grown in Maryland, as shown on the Plant Hardiness Zone map (Figure 1).
- Soil Drainage Class** (refer to the county soil survey for further information):
E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.
- Reed Canarygrass: Caution**—This species can spread into other pasture plantings, lawns, and cropland fields. **Do not plant unless containment of the planting is feasible, as determined and approved by NRCS.**