NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FORAGE AND BIOMASS PLANTING

(Acre)
CODE 512

DEFINITION

Establishing adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production.

PURPOSES

- Improve or maintain livestock nutrition and/or health.
- Provide or increase forage supply during periods of low forage production.
- Reduce soil erosion.
- Improve soil and water quality.
- Produce feedstock for biofuel or energy production

CONDITIONS WHERE PRACTICE APPLIES

Practice applies on all lands suitable to the establishment of annual, biennial or perennial species for forage or biomass production. The practice does not apply to the establishment of annually planted and harvested food, fiber, or oilseed crops.

CRITERIA

General Criteria Applicable to All Purposes

Plant species and their cultivars shall be selected based upon:

- Climatic conditions, such as annual precipitation and distribution, growing season length, temperature extremes and the USDA Plant Hardiness Zones.
- Soil condition and landscape position attributes such as pH, available water holding capacity, aspect, slope, drainage class, fertility level, salinity, depth, flooding and ponding, and levels of phytotoxic elements that may be present.
- Resistance to disease and insects common to the site or location.
- Compatibility with other forage species and their selected cultivar(s).

Species will be suitable for the planned purpose. The long-term objectives of the land user will be used in selection of vegetative cover. Monocultures are discouraged. Introduction of invasive and noxious species is prohibited. The use of native species from local genotypes is encouraged.

Specified seeding/plant material rates, methods of planting and date of planting shall be consistent with documented guidance cited by plant materials program, research institutions or agency demonstration trials for achieving satisfactory establishment.

Seeding rates will be calculated on a pure live seed (PLS) basis.

Plant seeds to proper depth ensuring seed or planting will contact soil moisture uniformly.

Prepare site to provide a medium that does not restrict plant emergence.

All seed and planting materials shall meet state quality standards.

Select plants that according to federal, state, or local regulations are not considered noxious or invasive species.

Apply all plant nutrients and/or soil amendments for establishment purposes according to a current soil test. Application shall be appropriately placed and timed to be effective.

If needed, legume seed shall be inoculated with the proper species of viable Rhizobia before planting.

Pre-inoculated seed, determine pure live seed percentage from seed tags – calibrate planting equipment accordingly.

Livestock shall be excluded until the plants are well established.

Select forage species based on the intended use, realistic expected yield, maturity stage, compatibility with other species and level of management that will be provided. Plant adaptation to the proposed planting area shall be verified prior to planting.

Additional Criteria for Improving or Maintaining Livestock Nutrition and/or Health

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

Forage species planted as mixtures will exhibit similar palatability to avoid selective grazing.

Additional Criteria for Balancing Forage Demand During Periods of Low Forage Production

Select plants that will produce forage for use during periods when other on-farm/ranch forage does not meet livestock needs. Forage species selected shall balance or help balance the dry matter demand of the animals for the desired period of time.

See Conservation Practice Prescribed Grazing (Practice Code 528) and Grazing Lands Technical Note No. 1 for strategies for matching livestock needs with forage availability.

Additional Criteria to Reduce Soil Erosion

Plants shall provide adequate ground cover, canopy cover, root mass, and vegetative retardance to protect soil against wind and water erosion.

All tillage operations will be performed as near to a contour as possible on slopes steeper than 2 percent. Perform tillage, planting, and mulching operations across the slope.

Fields are to be protected from erosion before and after vegetation establishment.

Proper species selection is critical on erosive soils to ensure a durable sod capable of providing long-term protection.

Companion crops may be required during establishment to ensure erosion control.

Additional Criteria for Producing Feedstocks for Biofuel or Energy Production

Select plants that provide adequate kinds and amount of plant materials needed (refer to Table 3 – Crop Use Information).

Biomass harvest frequency will be determined by assessing site conditions, growing season conditions, and species characteristics. Harvest frequency will be determined to prolong stand life.

CONSIDERATIONS

In areas where animals congregate, consider establishing persistent species that can tolerate close grazing and trampling.

On sites where wildlife and pollinator concerns exist, the food and cover value of the planting can be enhanced by using an approved habitat evaluation procedure to aid in selecting plant species and providing for other habitat requirements necessary to achieve the objective. Refer to Conservation Practice Upland Wildlife Habitat Management (Practice Code 645).

Where air quality concerns exist, site preparation techniques should be utilized that will minimize airborne particulate matter generation and transport.

Where carbon sequestration is a goal, select deep-rooted perennial species that will increase underground carbon storage.

Consider using crop residue or quick growing annuals to meet any immediate livestock needs.

Certified or source-identified seed should be utilized whenever possible.

Fertilizer spreaders may be used to broadcast seed along with the lime and fertilizer

requirements. Inert materials such as cracked corn, etc. may be used as bulk material to aid in seed dispersal.

Conservation Practices Fencing (Practice Code 382), Nutrient Management (Practice Code 590), Pipeline (Practice Code 516), Pest Management (Practice Code 595), Prescribed Burning (Practice Code 338), Prescribed Grazing (Practice Code 528A), and Watering Facility (Practice Code 614) may be used in combination with Forage and Biomass Planting.

PLANS AND SPECIFICATIONS

Specifications for establishment of forage or biomass planting shall be prepared for each site or management unit according to the criteria and considerations described.

Illinois seeding plan, job sheet, or other similar document shall be used to provide specifications for forage or biomass planting to the land user. Refer to **IL Job Sheet – JS512** for further guidance.

When formal stand evaluation is needed, use Agronomy Technical Notice No. IL-2 “Guidelines for Herbaceous Stand Evaluation”.

All specifications shall be consistent with Federal, State, and local regulations.

Cooperators using herbicides to control weed competition should be cautioned as follows:

- Read and follow all label directions and heed all precautions. If herbicides are handled or applied improperly, or if unused portions are not disposed of safely, they may contaminate water and soil, injure humans, domestic, animals, desirable plants, and fish or other wildlife. Herbicides should not be used over or directly adjacent to ponds, lakes or streams. Cooperators should be aware of and adhere to the provisions of local, county, state or federal laws and regulations concerning the use of agricultural chemicals.

Refer to Conservation Practice Pest Management (Practice Code 595) for additional information on pesticide use and safety.

Seeding Periods

Seeding periods are identified in **Table 1**. Seeding dates are based on long-term averages and variances may be allowed if obtained through proper channels. Seeding variance extensions will be based on both favorable moisture and temperature for seed germination.

Fertilizer and Lime Requirements

Soil fertility and pH level will be amended to satisfy the needs of the planned plant species. Soil fertility levels will be determined by an approved testing laboratory from soil samples collected in the area to be seeded. Soil test interpretations and lime fertility recommendations can be determined from the Illinois Agronomy Handbook for seeding establishment.

Recent soil tests are those tests that are no older than 4 years.

Minimum soil test levels for grazed pastures.

Legume	pH	P1	K
Alfalfa	6.5	30	300
Red Clover	6.0	25	250
Ladino Clover	5.5	25	250
Birdsfoot Trefoil	5.5	20	225
Lespedeza	5.0	20	200

Companion Crop

If erosion cannot be adequately controlled with one of the seedbed preparation options, a companion crop not to exceed 32 pounds of close sown (10 inch or less row spacing) small grain may be used in addition to the planned full seeding rate. Companion crops may be used with either spring or fall seedings.

For spring seedings of introduced species, oats shall be seeded at a rate of 1 bushel/acre to reduce soil erosion and help control weed competition. The oats shall be clipped at the time of seed head emergence to promote growth of the new permanent cover. The use of the companion crop is not required when

interseeding and is optional for all other seeding periods.

Spring grains such as oats, barley, or spring wheat with fall plantings will provide protection yet will not need to be controlled since they will be winter killed. Fall planted grains such as winter wheat, rye, or triticale planted in the spring at the suggested rates will not produce viable seed that require control.

Corn may be used as a companion crop when planting Eastern Gamagrass. Corn will be planted at the rate of 12,000 to 15,000 seeds per acre followed by Eastern Gamagrass planted at the rate of 8 pounds PLS per acre either between the corn rows or at a 25 degree angle to the corn rows. Planting can be accomplished with either a corn planter on 30-inch rows or by using a drill with unused holes taped up. The corn will be harvested to allow the stalks to remain for the winter to aid in catching snow to avoid frost-heaving during the establishment year.

Seedbed Preparation and Seeding

Conventional tillage for spring and late summer seeding periods where site conditions allow for safe operation of equipment:

- The seedbed shall be worked to a depth of 3" before seeding and shall be reasonably smooth, friable and firm before seeding. The seedbed will be made firm by rolling or cultipacking prior to seeding. The seedbed is firm if walking leaves footmarks no greater than 1/2" deep.
- All tillage operations shall be performed across the general slope of the land.
- Grass and legume seed shall be drilled uniformly over the area at a depth equal to 2 times the seed diameter, or broadcast uniformly over the area and rolled or cultipacked to ensure good seed to soil contact.
- Where erosion is a concern and conservation tillage is needed, prepare a seedbed with chisel, disk or other similar tool that will leave adequate residue to provide erosion protection.

No-till for spring, late summer and dormant seeding periods where site conditions allow for safe operation of equipment.

- Approved herbicides shall be applied to kill or suppress existing weed competition, as necessary.
- A drill designed for no-till planting shall be used to plant the seed at a depth equal to 2 times the seed diameter.

Frost Seeding

- Broadcast seed for only those species approved for frost seeding as shown in **Table 2**.
- Frost seeding rates in **Table 2** have been increased by a factor of 1.5.

Seeding Stand Improvement

(Includes any stand modification that maintains some vegetative component of the original stand.)

Incorporation of grasses and/or legumes with light tillage.

- Weaken the existing stand in the fall or early winter by use of herbicides, grazing, mowing or a combination of these methods.
- Use a disk, cultivator, or similar tool to disturb 40-50% of the existing stand.
- Grass and legumes shall be drilled uniformly over the area at a depth equal to 2 times the seed diameter, or broadcast uniformly over the area and rolled or cultipacked to ensure good seed to soil contact.
- Remove early spring regrowth by mowing to reduce competition and allow the new seedlings to become established.

Incorporation of grasses and/or legumes with no-tillage (interseeding) for spring, late summer and dormant seeding periods.

- When interseeding into existing sod, graze, burn, mow or apply herbicides to kill strips or suppress existing vegetation and to control weed competition.

- Control broadleaf weeds by applying herbicide at least two weeks prior to applying contact herbicides and prior to seeding.

- Grass and legumes shall be drilled uniformly over the area at a depth equal to 2 times the seed diameter.

- Remove early spring regrowth of existing species by mowing to reduce competition and allow the new seedlings to become established.

Incorporation of grasses and/or legumes with frost seeding.

- Broadcast seed only species approved for frost seeding as shown in **Table 2**. Small smooth (shiny) seeded species are best for incorporation into the soil during freezing and thawing.

- Weaken the existing stand in the fall or early winter by use of herbicides, grazing, mowing or a combination of these methods.

- Frost seeding is likely to be more successful if existing stand is weak and less than 50 percent of the ground is covered with live vegetation.

Legume Inoculation

Legume seeds shall be treated with a pure culture of nitrogen fixing bacteria prepared specifically for the species being seeded. Where more than one legume is included in the seed mixture, inoculate each species separately. A sticker, as recommended by the inoculant manufacturer, will be used to secure the bacteria to the seed. Refer to Illinois Agronomy Technical Note Number 20 for guidance.

Uncoated seed pre-inoculated greater than 60 days will be re-inoculated. Pre-inoculated seed that has been coated must be seeded within 12 months of inoculation, otherwise re-inoculate. In no cases shall inoculum be used after the expiration date including inoculum that is included with the seed as a pre-treatment.

Legumes not pre-inoculated will be inoculated within 24 hours of seeding.

Inoculation of native legumes is recommended when commercial inoculum is available.

Seed Quality

All seed shall be of high quality and comply with Illinois Seed and Weed Laws; and originate from the United States or Canada.

All seed shall comply with Illinois Seed and Weed Laws and originate from the United States or Canada.

Seed rates will be based on Pure Live Seed (PLS) per acre. Computation of Pure Live Seed will based on the following formula:

$$\text{PLS} = \frac{(\%\ \text{germination} + \%\ \text{dormant seed})\ X\ \%\ \text{purity}}{100}$$

Germination tests are required for all warm and cool season grasses and legumes (excluding companion crops). Germination tests may not be older than 12 months at time of seeding excluding the month of testing. Germination tests are not required for native forbs

Approved Plant Species and Seeding Rates

Plant species and cultivars shall be selected based upon:

- Climatic conditions such as annual rainfall, seasonal rainfall, growing season length, humidity levels, temperature extremes, the USDA Plant Hardiness Zones, and the Illinois Plant Suitability Zones.

- Soil condition and position attributes such as: pH, percent slope, available water holding capacity, aspect, drainage class, inherent fertility, flooding and ponding, and levels of salinity and alkalinity.

- Plant characteristics such as season of growth, vigor, ease of establishment, longevity of the species, growth habits, adaptation to soil conditions, and conservation value.

- Resistance to diseases and insects common to the site or location.

- Compatibility with other plant species and their selected cultivars in rate of establishment and growth habit when seeded together as a mixture.

Seeding Rates

Seeding rates are based on the optimum amount of seed necessary to provide vegetative cover in a reasonable amount of time. The pure stand rates in **Table 2** are the minimum rates for planting a single species stand into well-prepared seedbed at the proper placement. The pure stand rates are decreased to a percentage of the desired stand when used to calculate a mixture of two or more species.

Select combinations of plant species and cultivars best adapted to site conditions.

- For more information on species crop use, - see **Table 3**; for site hazards - see **Table 4;** and for soil suitability and/or adaptation refer to Illinois Field Office Technical Guide, Section II, Pasture and Hayland Interpretations *(Forage Suitability Groups under development*).

- For more information on introduced cultivar selection, refer to http://plants.usda.gov/, under "Plant Topics" select characteristics. Either search by plant name or select common or scientific name for a list of database plants. Select the plant of choice then select plant characteristics to view plant characteristics and cultivars.

Cool Season Grass/Legume Species

- Approved plant species, allowable mixture composition and the pure stand seeding rates are shown in **Table 2**.

- Pastures seeded to mixtures for grazing may include up to 40% legumes, by weight (20% legumes for sheep and goats). Use the criteria for the predominant species in the mixture for stand establishment.

Warm Season Grass Species

- Approved plant species, allowable mixture composition and pure stand seeding rates are shown in **Table 2**.

- A designed seeding mixture shall meet criteria specified in **Table 2** as to species composition and seeding rate. At least 50% of the mixture shall be composed of grasses. For seeding mixtures with the secondary purpose of wildlife, not more than 20% of the mixture will be composed of switchgrass.

- Pastures seeded to mixtures for grazing may include up to 40% legumes, by weight (20% legumes for sheep and goats). Use the criteria for the predominant species in the mixture for stand establishment.

For more information on warm season grasses used for biomass refer to **Table 3** and **Technical Note No. 3** - Planting and Managing Switchgrass as a Biomass Energy Crop, which along with other information can be found at: http://plant-materials.nrcs.usda.gov/technical/biofuel.html

Weed Control during the Establishment Year

Weed control during the establishment year shall be provided to ensure survival of the new seeding. If there is an existing broadleaf weed problem, use pest control measures to reduce the competition prior to establishing the new seeding.

- To manage severe weed competition, warm season grass species may be mowed no closer than 8 inches and cool season grass/legume species no closer than 4 inches.

- Approved herbicides may be used on both cool and warm season grass plantings to control weed species. Herbicide use is limited in grass/legume mixtures.

OPERATION AND MAINTENANCE

To maintain productivity, soil tests should be taken according to University of Illinois prescribed methods every 4 years. Apply lime and fertilizer according to Illinois Agronomy Handbook.

In a diverse species mixture that includes both tall grasses and legumes, the height of the tall grasses will need to be controlled to allow

sunlight to reach the legumes. Legumes also need to be rested during the grazing or haying season. Short-lived legumes should be allowed time to reseed every 4 years. Red Clover will need approximately 30 days of rest to allow for seed formation. Birdsfoot Trefoil and Lespedezas will need approximately 45 days.

Growth of seedlings shall be monitored for water stress. Water stress may require reducing weeds; early harvest of any companion crops or replanting failed stands, depending on the severity of drought.

Invasion by undesirable plants shall be controlled by cutting, using a selective herbicide, or grazing management through manipulation of livestock kind, type, stocking rates, density, and duration.

Insects and diseases shall be controlled when an infestation threatens stand survival.

When plant vigor declines, the application of maintenance levels of plant nutrients may be necessary. Refer to Nutrient Management, Practice Code 590, for recommendations.

Where plant vigor declines in warm season grass species or where invader species threaten native mix stands, burning may be appropriate. See Prescribed Burning, Practice Code 338 for additional information on burning criteria.

DOCUMENTATION

The following items shall be considered when developing a Forage and Biomass Planting Plan. Those items marked with an asterisk (*) shall be recorded as minimum documentation requirements. The use of computer programs is considered adequate documentation if the programs contain information as outlined in the plan and the following:

* Location of fields marked on the conservation plan's Plan Map (or have individual maps)
* Soil types mapped or noted.
* Acres to be treated
* Seeding Recommendations
  - Species and percent of mixture
  - PLS seeding rate per acre
  - Seeding date windows
  - Type of seedbed preparation used
  - Planting method
  - Weed control method, including pre- and post-herbicide recommendations (if any)
  - Adequacy of seeding
* Pest and Nutrient Management Plan
* Seed tags/invoice with seed bag contents and origin, percent purity, and percent germination.
* Operation and planned maintenance

  Soil Erosion Control measures used

REFERENCES

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Cooperative Extension Service, Illinois Agronomy Handbook, University of Illinois, 24th Edition.

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Barnes, R.F., D.A. Miller, and C.J. Nelson. 1995. Forages, The Science of Grassland Agriculture, 5th Ed. Iowa State University Press, Ames

United States Department of Agriculture, Natural Resources Conservation Service. 1997. National Range and Pasture Handbook. Washington, DC.

USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 08October 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

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Table 1 - Acceptable planting dates by Plant Suitability Zones

Type of Seeding	Plant Suitability Zone[1]	Cool Season Species	Warm Season Species[2]
Spring	I	Late Winter - June 1	Late Winter - June 15
	II	Late Winter - May 15	Late Winter - June 5
	III	Late Winter - May 15	Late Winter - June 1
Late Summer	I	August 1 - September 1	Not Recommended
	II	August 1 - September 10	Not Recommended
	III	August 1 - September 20	Not Recommended
Dormant	I		November 1 - Freeze-up
	II		November 15 - Freeze up
	III		November 15 - Freeze up
Frost[3]	I	February 1 - March 15	February 1- March 15
	II	February 1 - March 1	February 1 -March 1
	III	February 1 - March 1	February 1 - March 1

[1] - Refer to the "Plant Suitability Zones" map located in Section II, IL-eFOTG-Climatic Data or refer to the link: http://efotg.nrcs.usda.gov/references/public/IL/c12plant.pdf
[2] - Dates to be used when warm and cool season natives are planted in mixture.
[3] - Refer to **Table 2** for applicable plant species. Frost seeding may be performed in December and January when snow cover is absent.

Table 2. Seeding chart

Plant Species	Legal wt. Per Bu (lb.)	Seeds per lb.	Seeds per sq. ft @ 1 lb. pls/Ac.	Minimum Seeding Rate = pounds PLS/acre (e)			
				Pure stand	Frost Seeding	Note	In Mixture
Legumes							
Alfalfa	60	200,000	5.0	12	NR		4-10
Alsike Clover	60	700,000	15.8	5	3	ac	1-3
Birdsfoot Trefoil	60	375,000	8.7	8	NR		2-5
Cicer Milk Vetch	60	135,000	3.1	25	NR		10-15
Crownvetch	60	120,000	2.8	10	10	a	5-8
Hairy Vetch	60	20,000	0.5	25	15	a	10-15
Kura Clover	60	218,000	5	18	NR		8
Lespedeza (Annual)	40	225,000	5.4	20	15	abd	10-15
Ladino Clover	60	800,000	18.4	3	2	c	1/2-1
Mammoth Red Clover	60	295,000	6.8	10	8	a	4-6
Medium Red Clover	60	275,000	6.3	10	8	a	4-6
Sweetclover	60	260,000	6.0	10	NR	d	4-8
Cool Season Grasses (C3)							
Canada Wildrye		115,000	2.6	10	NR		4-5
Kentucky bluegrass	14	2,177,000	50.0	15	NR		2-5
Orchardgrass	14	654,000	15.0	8	8	a	3-6
Perennial ryegrass	24	227,000	6.3	15	10	a	5-10
Red top	14	4,990,000	114.6	4	NR	c	1-3
Smooth bromegrass	14	136,000	3.1	16	NR		4-10
Tall fescue	25	227,000	5.2	10	NR		4-8
Timothy	45	1,200,000	27.5	6	4		2-4
Virginia Wildrye		73,000	1.7	15	NR		4-5

a. Species suitable for frostseeding. Frost seeding rates shown are for interseeding, not for pure stands. Rates are for pastures with less than 15% legumes in stand by weight. Reduce rates by ½ if more than 15% legumes in stand by weight.
b. Annual lespedezas are adapted to Suitability Zones 2 and 3 only. Common Korean and Summit are recommended varieties of Korean Lespedeza. Kobe and Marion are recommended varieties of Striate Lespedeza.
c. Not recommended as a pure stand.
d. Use scarified seed.
e. Pounds of pure live seed (PLS).

$$PLS = \frac{[(\%\ Germination + \%\ hard\ seed)\ X\ \%\ Purity]}{100}$$

N/A = Not Applicable
NR = Not Recommended

Table 2. Seeding chart

Plant Species	Legal wt. Per Bu (lb.)	Seeds per lb.	Seeds per sq. ft @ 1 lb. pls/Ac.	Seeding Rate = pounds PLS/acre (e)			
				Pure stand	Frost Seeding	Note	In Mixture
Warm Season Grasses (C4)							
Big Bluestem	8 or 25	165,000	3.8	10	NR	f	5-6
Caucasian Bluestem		860,000	19.7	2.5	NR		
Eastern Gamagrass		7,500	2	8-10	NR	d	
Indiangrass	8 or 25	175,000	4.0	10	NR	f	5-6
Little Bluestem		225,000	5.0	6	NR		3
Prairie Dropseed		1,200,000	28.0	4	NR		1
Sideoats Grama		190,000	4.4	6	NR		3
Switchgrass	40	389,000	8.9	5	5	a	3
ANNUAL FORAGES							
Annual Ryegrass (Italian)	24	227,000	N/A	20-25	20	a	
Barley	48	14,000	N/A	2 Bu	NR		1-2
Forage Chicory	-		N/A	3-4	NR	g	
Millet, Pearl	48	85,000	N/A	20	NR		
Proso	56	65,000	N/A	20	NR		
Foxtail/German	50		N/A	20	NR		
Oats	32	13,000	N/A	2-3 Bu	NR		
Kale	-	140,000	N/A	4			
Rape	50	145,000	N/A	4	NR		
Swedes	-	190,000	N/A	1.5 - 2	NR		
Turnips	-	190,000	N/A	1.5 - 2	NR		
Cereal Rye	56	18,000	N/A	1.5-2 Bu	NR		
Sorghum-Sudangrass	-	15-20,000	N/A	20-25	NR		
Sudangrass	32	g	N/A	25	NR	g	
Wheat/Triticale	60	12,000	N/A	1.5-2 Bu	NR		

a. Species suitable for frostseeding increase seeding rate by a factor of 1.5.
b. Annual lespedezas are adapted to Suitability Zones 2 and 3 only. Common Korean and Summit are recommended varieties of Korean Lespedeza. Kobe and Marion are recommended varieties of Striate Lespedeza.
c. Not recommended as a pure stand.
d. Use scarified seed.
e. Pounds of pure live seed (PLS).

$$PLS = \frac{[(\%\ Germination + \%\ hard\ seed)\ X\ \%\ Purity]}{100}.$$

f. 8 pounds debearded or 25 pounds bearded.
g. Variable number of seeds per pound due to differing subspecies
N/A = Not Applicable
NR = Not Recommended

Table 3. Crop Use Information (E=excellent, G=good, F=fair, P=poor).

Forage Species	Annual or Perennial	HAY	Silage	Continuous Grazing	Prescribed Grazing	Palatability	Biomass Production
Legumes							
Alfalfa	Perennial	E	E	P	E	E	NR
Alsike Clover	Short-lived perennial	G	G	P	G	E	NR
Birdsfoot Trefoil	Perennial	G	E	F	G	G	NR
Cicer Milk Vetch	Perennial	F	G	F	G	E	NR
Crownvetch	Perennial	F	G	F	G	G-F	NR
Hairy Vetch [a]	Winter annual	F	P	P	F	F	NR
Kura Clover	Perennial	G	G	E	E	E-G	NR
Lespedeza (Korean)	Annual	F	F	F	G	G	NR
Ladino Clover	Perennial	F	G	G-F	E	E	NR
Mammoth Red Clover	Short-lived perennial	F	G	P	P	G	NR
Medium Red Clover	Short-lived perennial	G	E	P	G	E	NR
Sweetclover	Biennial	F-P	G	P	F	F	NR
Cool Season Grasses							
Canada Wildrye	Perennial	F	F	P	E	E	NR
Kentucky bluegrass	Perennial	F	G F	E	E	E	NR
Orchardgrass	Perennial	E	G	F	E	F-G	NR
Perennial ryegrass	Short-lived perennial	E	E	F-G	G-E	E	NR
Red top	Perennial	F	F	F	F	G-F	NR
Smooth bromegrass	Perennial	E	E	F	E	E	NR
Tall fescue	Perennial	G-F	G	G-E	G-E	F-P	NR
Timothy	Perennial	E	E	F-P	G	E	NR
Virginia Wildrye	Perennial	F	F	F	E	E	NR
Warm Season Grasses							
Big Bluestem	Perennial	G	F	F	E	G-E	G
Caucasian Bluestem	Perennial	F	F	P	G	F	G
Eastern Gamagrass	Perennial	E	F	P	E	E	G-E
Indiangrass	Perennial	F	F	F	G	G	G
Little Bluestem	Perennial	P	P	F	G	G-F	NR
Prairie Dropseed	Perennial	F	F	F	G	G-F	NR
Sideoats Grama	Perennial	F	F	F	G	G	NR
Switchgrass	Perennial	F	F	F	G	G-F	E
Annual Forages							
Chicory	Short-lived perennial	P	P	G	G	G-P	NR
Foxtail/German Millet	Annual	F	F	F	G	G-F	NR
Hyb. Pearl Millets	Annual	F	F	F	G	G-F	NR
Rape	Annual	P	P	F	G	E	NR
SorghumXSudan	Annual	F	G	F	G	G-F	G-E
Sudangrass	Annual	F	F	F	G	G-F	G
Turnips	Annual	P	P	F	G	E	NR

a. Used primarily as a cover crop
NR = Not Recommended

Table 4: Crop description, relative tolerance of established forages to environmental conditions, and ease of establishment (H = High, M = Medium, L = Low).

CROP	Cold Frost	Drought	Wetness	Acidity	Optimal pH range	Ease of Establishment	Growth Habit	Minimum Drainage Class	Anti-Quality Component
Legumes									
Alfalfa[1]	M	M-H	L	L	6.6 - 7.2	H	T	MWD	B
Alsike Clover	M	L	M-H	M	6.0 - 6.5	M	M	VPD	B,P
Birdsfoot Trefoil[1]	M	L-M	M-H	M	6.0 - 6.8	L	M-S	SPD	T
Cicer Milk Vetch	M	M	L-M	M	5.8 - 6.5	L	T	MWD	
Crownvetch	M	M	L	H	5.8 - 6.5	L	T	MWD	G
Hairy Vetch	L-M	L-M	L-M	L-M	5.8 - 6.5	M	Viney	MWD	
Kura Clover	H	L-M	M-H	L-M	5.5 - 6.2	L	M-S	SPD	B
Lespedeza(Korean)[2]	L	M	L	L-M	6.0 - 6.5	M	S	MWD	T
Ladino Clover	L-M	L	M-H	L-M	6.0 - 6.5	L-M	S	PD	B
Mammoth Red Clover	L-M	L	L-M	L-M	6.2 - 6.8	M	M	PD	B
Medium Red Clover	M	L-M	L-M	L-M	6.2 - 6.8	M-H	M	PD	B
Sweetclover	M	M	L	L	6.8 - 7.2	L-M	T	MWD	B.C
Cool Season Grasses (C3)									
Canada Wildrye	M	M	H-M	M	5.0 - 7.9	L	M	SPD-MWD	
Kentucky Bluegrass	H	L	M	M	5.8 - 6.5	M	S	SPD	
Orchardgrass:	M	M	M	M	5.0 - 7.5	M-H	M	PD	
Perennial Ryegrass[3,4,5]	L	L	M	M	5.0 - 8.3	H	M-S	SPD	ET
Redtop	H	M-H	M	H	5.4 - 6.2	M	S	VPD	
Smooth Brome	H	M-H	M	M	5.8 - 6.5	M	T-M	MWD	
Tall Fescue[5]	M	M-H	M	H	5.4 - 6.2	M	M	VPD	A, ET
Timothy	M	M	L	M	5.4 - 6.2	M	M	MWD	
Virginia Wildrye	H	M	H-M	M	5.0 - 7.4	L	M	SPD-MWD	

Growth Habit **T** = Tall **M** = Moderate **S** = Short

Minimum Drainage Class: **WD**=Well Drained; **MWD**=Moderately Well Drained; **SPD**=Somewhat Poorly Drained; **PD**=Poorly Drained; **VPD**=Very Poorly Drained

Anti-Quality Components:	Footnotes:
A= Alkaloids (decrease palatability) B= Bloat Potential C= Coumarin (hemorrhagic agent. formed during spoilage of hay) CG= Cyanogenic Glycosides (may form hydrogen cyanide-HCN poisoning; also Prussic Acid Poisoning) ET= Endophyte Toxicity (reduce blood circulation to appendages "dry gangrene") G= Glycosides (decrease palatability) P= Photosensitization (sunburn on animals with light colored hair, reduce animal performance) T= Tannins (decrease palatability)	1. Select erect varieties for hay and prostrate varieties for pasture. 2. Limited to Plant Zones II and III, must be allowed to mature and reseed a stand for the next year 3. Select the more winter hardy varieties for use in IL. 4. Select the low-alkaloid varieties to improve palatability. 5. Select the endophyte-free varieties to improve animal performance.

Table 4: Crop description, relative tolerance of established forages to environmental conditions, and ease of establishment (H = High, M = Medium, L = Low).

CROP	Cold Frost	Drought	Wetness	Acidity	Optimal pH range	Ease of Establishment	Growth Habit	Minimum Drainage Class	Anti-Quality Component
Warm Season Grasses (C4)									
Big Bluestem	M	H	L	M	5.4 - 6.2	L	T	SPD-MWD	
Caucasian Bluestem	L	H	L	M	5.0 - 8.0	L	M-T	SPD-MWD	
Eastern gamagrass	M	H	H	M	5.0 - 8.2	L	T	VPD	
Indiangrass	M	H	L	M	5.4 - 6.2	L	T	MWD	
Little Bluestem	M	H	L	L		L	M	MWD	
Prairie Dropseed	M	H	L	L		L	M	WD	
Sideoats Grama	M	H	L	L		L	M	MWD	
Switchgrass	H	H	H	M	5.4 - 8.2	L	M-T	VPD	
Annual Forages									
Annual Ryegrass	L	L	H	M	5.6 - 6.2	H	M-S	SPD	
Chicory	M	M	M	M	5.0 - 8.3	H	S	MWD	G
Foxtail/German Millet	L	M	M	M	6.2 - 6.8	H	T	MWD	
Hybrid Pearl Millets	L	M	M	M	6.2 - 6.8	H	T	SPD	
Rape/Kale	H	M	M	M	5.3 - 6.8	H	S	MWD	G
SorghumXSudan	L	H	M	M	6.0 - 6.5	H	T	SPD	CG, N, P
Sudangrass	L	H	M	M	6.0 - 6.5	H	T	SPD	CG, N, P
Turnips/Swedes	H	M	M	M	5.3 - 6.8	H	S	SPD-MWD	G, P

Growth Habit **T** = Tall **M** = Moderate **S** = Short

Minimum Drainage Class: **WD**=Well Drained; **MWD**=Moderately Well Drained; **SPD**=Somewhat Poorly Drained; **PD**=Poorly Drained; **VPD**=Very Poorly Drained

Anti- Quality Components:	Footnotes:
A= Alkaloids (decrease palatability) B= Bloat Potential C= Coumarin (hemorrhagic agent. formed during spoilage of hay) CG= Cyanogenic Glycosides (may form hydrogen cyanide-HCN poisoning; also Prussic Acid Poisoning) ET= Endophyte Toxicity (reduce blood circulation to appendages "dry gangrene") G= Glycosides (decrease palatability) P= Photosensitization (sunburn on animals with light colored hair, reduce animal performance) T= Tannins (decrease palatability) N = Nitrates P = Prussic acid	1. Select erect varieties for hay and prostrate varieties for pasture. 2. Limited to Plant Zones II and III, must be allowed to mature and reseed a stand for the next year 3. Select the more winter hardy varieties for use in IL. 4. Select the low-alkaloid varieties to improve palatability. 5. Select the endophyte-free varieties to improve animal performance.

Table 5. Key for selecting the most suitable legumes to plant on hay or pasture lands differing in soil drainage, fertility and pH level

Drainage Condition	Fertility Level	pH Level	Adapted Legumes (most to least desirable)
Well Drained	High Fertility	pH above 6.5	Alfalfa, Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino or White Clover
	Moderate Fertility	pH above 6.5	Alfalfa, Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino or White Clover
	Low Fertility	pH above 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover, Lespedeza[2]
Moderately Well Drained	High Fertility	pH above 6.5	Alfalfa, Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover, Lespedeza[2]
	Moderate Fertility	pH above 6.5	Alfalfa, Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover, Lespedeza”
	Low Fertility	pH above 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover, Lespedeza [2]
		pH below 6.5	Birdsfoot Trefoil [1], Ladino Clover, Lespedeza [2]
Somewhat Poorly Drained to Poorly Drained	High Fertility	pH above 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover, Lespedeza [2]
	Moderate Fertility	pH above 6.5	Red Clover, Birdsfoot Trefoil [1], Ladino Clover
		pH below 6.5	Birdsfoot Trefoil [1], Ladino Clover, Lespedeza [2]
	Low Fertility	pH above 6.5	Alsike Clover, Birdsfoot Trefoil [1], White Clover, Lespedeza [2]
		pH below 6.5	Alsike Clover, Birdsfoot Trefoil [1], White Clover, Lespedeza [2]
Poorly Drained to Very Poorly Drained	High Fertility	pH above 6.5	Red Clover, Ladino Clover, Alsike Clover
		pH below 6.5	Red Clover, Ladino Clover, Alsike Clover
	Moderate Fertility	pH above 6.5	Red Clover, Ladino Clover, Alsike Clover
		pH below 6.5	Ladino Clover, White Clover, Alsike Clover
	Low Fertility	pH above 6.5	Alsike Clover, White Clover
		pH below 6.5	Alsike Clover, White Clover

[1] Birdsfoot Trefoil is generally adapted only to Plant Suitability Zones I and II in Illinois.

[2] Lespedeza is generally adapted only to Plant Suitability Zones II and III in Illinois.

Table 6. List of frequently used forage seed mixtures for specific site conditions

Hay Crop		
USE	**SPECIES**	**LBS. PLS/AC**
Excessively Drained Soils (Droughty Soils)	Alfalfa or Lespedeza Smooth Bromegrass or Orchardgrass or Tall Fescue	8 and 8 or 4 or 6
Moderately Drained to Well Drained Limed or nonacid Fertile soils	Alfalfa	12
	Alfalfa in mixture with: Smooth Bromegrass or Orchardgrass	10 and 8 or 4
	Red Clover	10
	Red Clover or Kura Clover in mixture with: Smooth Bromegrass or Orchardgrass	8 and 8 or 4
Somewhat Poorly Drained to Poorly Drained Soils, slightly acid soils	Alsike Red Clover Orchardgrass or Tall Fescue	2 and 4 and 4 or 8
	Red Clover Orchardgrass or Tall Fescue	6 and 4 or 8
	Eastern Gamagrass	10
Poorly Drained to Very Poorly Drained soils	Red Clover Alsike Clover Tall Fescue	5 and 2 and 8
	Birdsfoot Trefoil Tall Fescue	5 and 8
	Alsike Clover Tall Fescue or Red Top	3 and 8 or 3
	Eastern Gamagrass	10

Table 6 Continued. List of frequently used forage seed mixtures for specific site conditions

Rotation and Permanent Pastures		
USE	**SPECIES**	**LBS. PLS/AC**
Well Drained Soils (Droughty Soils)	Smooth Bromegrass	16
	Alfalfa Smooth Bromegrass or Tall Fescue	8 and 8 or 6
	Tall Fescue	10
Moderately to well drained limed or nonacid fertile soils * Red clover at 4-lbs. pls/ac can be substituted for 1/2 of the alfalfa seed.	Alfalfa * Smooth Bromegrass or Orchardgrass	6 and 8 or 4
	Alfalfa * Timothy Smooth Bromegrass or Orchardgrass	6 and 2 and 6 or 4-6
	Smooth Bromegrass	16
	Indian Grass Big Bluestem	5 5
	Eastern Gamagrass	10
Somewhat Poorly Drained to Poorly Drained, slightly acid soils	Red Clover Ladino Clover Orchardgrass	6 and ½ and 4
	Ladino Clover Orchardgrass Tall Fescue	1 and 4 and 8
	Birdsfoot Trefoil Orchardgrass or Tall Fescue	5 and 5 or 8
	Tall Fescue Orchardgrass	8 and 4
	Big Bluestem	10
	Switchgrass	5
	Eastern Gamagrass	10
	Alsike Clover Ladino Clover Orchardgrass or Perennial Ryegrass or Tall Fescue	3 ½ 4-6 or 5-10 or 8
Poorly drained to Very Poorly Drained soils	Birdsfoot Trefoil Tall Fescue	5 and 8
	Alsike Clover Ladino Clover Tall Fescue	3 ½ 8
	Tall Fescue	10
	Switchgrass	5
	Eastern Gamagrass	8-10
	Ladino Clover Tall Fescue	1 and 8

Table 6 Continued. List of frequently used forage seed mixtures for specific site conditions

USE	SPECIES	LBS. PLS/AC
Pasture for Horses	Alfalfa Kentucky Bluegrass Smooth Bromegrass or Orchardgrass	6 and 2 and 8 or 4
	Ladino Clover Kentucky Bluegrass Timothy or Smooth Bromegrass or Orchardgrass	½ and 4 and 2 or 6 or 4
	Smooth Bromegrass Birdsfoot trefoil Timothy or Kentucky Bluegrass	6 and 5 and 2 or 4
Pasture for Hogs	Alfalfa Ladino Clover	8 and 2
	Forage Rape Oats	4 and 1½ Bu/ac
Supplemental Pasture	Sudangrass	25
	Hybrid Pearl Millet	20
	Oats	2-3 Bu/ac
	Foxtail/German Millet	25
	Winter Rye (fall planted)	1½ - 2 Bu/ac
	Forage Rape Oats	4 and 1½ Bu/ac
	Forage Turnips and Swedes	1½-2 lbs./ac
	Rape and Kale	4 lbs./ac
	Oats and Cereal Rye	1 Bu/ac and 1½ Bu/ac
	Cereal Rye and Oats and Turnips	1½ Bu/ac and 1 Bu/ac and 2 lbs/ac
	Oats and Turnips	2 Bu/ac and 2 lbs/ac
	Triticale or Wheat	2 Bu/ac