SELECTING FORAGE SPECIES

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Forage grass and legume performance varies depending on environmental conditions. No single forage type or variety is best in all environments. The adaptation of a species, or its potential longevity in the field, is determined greatly by genetic cold-hardiness traits, and its tolerance of other site, soil, and use conditions.

When selecting a forage species, or several species for use in a seed mixture, first consider their appropriateness for the intended use (pasture, hay, etc.) and for the expected longevity on the site (Table 1).

Among the other factors that affect the suitability of a forage species are:

- drought tolerance
- soil pH level
- fertilizer nutrient requirements
- soil drainage
- intensity
- harvest or grazing

TABLE 1. General Crop Use Information (E= excellent, G=good, F=fair, P=poor)

CROP	ANNUAL or PERENNIAL	HAY	SILAGE	PASTURE (GRAZING) CONTINUOUS	PASTURE (GRAZING) CONTROLLED	PALATABILITY
LEGUMES						
Alfalfa	Perennial	E	E	P	E	E
Alsike clover	Short-lived Perennial	G	G	P	G	E
Birdsfoot trefoil	Perennial	F	F	G	G	G
Hairy vetch	Winter Annual	USED PRIMARILY AS A COVER CROP				
Kura clover	Perennial	G	G	E	E	E-G
Lespedeza (Korean)	Annual	F	F	F	F	G
Mammoth red clover	Short-lived Perennial	F	G	P	P	G
Medium red clover	Short-lived Perennial	G	E	F	G	E
Sweetclover	Biennial	F-P	G	P	F	F
White clover: Ladino	Perennial	F	F	E	E	E
White clover: medium and small leaf types	Perennial	P	P	E	E	E
GRASSES						
Big bluestem	Perennial	G	G	F	G	G
Foxtail/German Millet	Annual	F	F	F	G	F
Hyb Pearl Millet	Annual	F	F	F	G	G-F
Indiangrass	Perennial	F	F	G	G	G
Kentucky bluegrass	Perennial	P	P	E	E	E
Orchardgrass	Perennial	E	G	E	E	F
Redtop	Perennial	F	F	F	F	G-F
Reed canarygrass	Perennial	G	G	F	G	G-P
Ryegrass-Annual	Annual	F	G	G	G	G
Ryegrass-Perennial	Short-lived Perennial	G	E	E	E	E
Smooth bromegrass	Perennial	E	E	P	E	E
SorghXSudan Hyb	Annual	P	G	P	G	G-F
Sudangrass	Annual	P	F	F	G	G-F
Switchgrass	Perennial	G	G	F	G	G-F
Tall fescue	Perennial	G	G	G	G	F-P
Timothy	Perennial	E	E	F	G	E-G
OTHER & MINOR USE						
Chicory	Short-lived Perennial	P	P	G	G	G-P
Cicer milkvetch-legume	Perennial	F	G	G	G	E
Crownvetch-legume	Perennial	F	G	F	G	G-F
Rape and Turnips	Annual	P	P	F	G	G-F
Teff-grass	Annual	G	G	P	F	F

Once several possible candidates are selected, consider how these species might be suited to the conditions of your specific field(s) (Tables 2 and 3). Soil drainage and their relative tolerance of low soil fertility or pH conditions (Table 3) often limit the persistence of legumes. Table 2 categorizes species on the basis of their relative height and cautions about known potential anti-quality traits.

TABLE 2. Crop description, relative tolerance of established forages to environmental hazards, and ease of establishment (E=excellent, G=good, F=fair, P=poor).

FORAGE CROP	COLD FROST	SOIL DROUGHT	SOIL WETNESS	SOIL ACIDITY	EASE OF ESTABLISHMENT	GROWTH HABIT*	PALATABILITY	ANTI-QUALITY COMPONENTS**
LEGUMES								
Alfalfa	G	G	P	P	G-E	T	E	B
Alsike clover	F	F	G	G	F	M	E	B,P
Birdsfoot trefoil	G	F	G	G	P	M-S	G	T
Hairy vetch	F	F	F	F	G	VINY		
Kura clover	E	E	F	F	P	M-S	E	B
Lespedeza (Korean)	P	G	F	F	G	S	G	T
Mammoth red clover	F	F	F	F	G	M	G	B
Medium red clover	G	F	F	F	G-E	M	E	B
Sweetclover	G	G	P	P	F	T	F	B-C
White clover: Ladino	F	P	G	F	F	S	E	B
White clover: medium and small leaf types	F	P	G	F	F	S	E	B
GRASSES								
Big bluestem[3]	G	E	P	G	P	T	E	
Foxtail/German Millet	P	G	F	F	E	T	F	
Hyb Pearl Millet	P	G	P	F	G	T	G	
Indiangrass[3]	G	E	P	G	P	T	G	
Kentucky bluegrass	E	F	G	G	F	S	E	
Orchardgrass[3]	F	F	F	F	G	M-S	G	
Redtop	E	G	F	E	F	S	G-F	
Reed canarygrass[4]	F	G	E	G	P	T	G-P	A
Ryegrass-Annual	P	P	G	F	E	M-S	G-F	
Ryegrass-Perennial[3, 4]	P	P	G	F	E	M-S	E	
Smooth bromegrass	E	G	F	F	F	T-M	E	
SorghXSudan Hyb	P	E	P	F	E	T	F	CG
Sudangrass	P	E	P	F	E	T	F	CG
Switchgrass[3]	G	E	F	G	P	T	F	
Tall fescue[5]	E	G	G	E	G	T-M	F-G	A,ET
Timothy	G	F	G	G	F-G	M-T	E	
OTHER								
Chicory	F	F	F	G	G	S	G	
Cicer milkvetch-legume	G	F	F	G	P	T	E	P
Crownvetch-legume	G	G	P	E	P	T	G-F	G-T
Rape and Turnips	E	F	F	F	G	S	G	P
Teff-grass	P	F	F	M	F	M	G-F	

Growth Habit: T = Tall; M = Moderate; S = Short

**Anti-quality components:

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") (variety dependent)
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 extreme southern Iowa, must be allowed to mature and reseed a stand for the next year.
3	Select the more winterhardy varieties for use in Iowa.
4	Select the low-alkaloid varieties to improve palatability.
5	Select the endophyte-free varieties to improve animal performance.

Mixtures of legumes and grasses often give the best overall performance for pasture and multi-use hay/pasture meadows. Yields tend to be greater with mixtures than with either a grass or legume alone. Mixtures of two or three well-chosen legumes or grasses are usually more desirable than mixtures that include five or six. Each selected grass and legume in the mixture should have a specific purpose.

Table 4 may be useful for those who want to modify, alter, or design their own seeding mixture. Mixtures are usually composed to provide about 70 to 100 seeds per square foot. With a seeding year stand count goal of 10 to 20 plants per square foot, this may seem like a high number of seeds to plant. However, seedling death rates are surprisingly high (40-60 percent) because of a wide variety of seeding and seedbed conditions, primarily moisture-and disease-related. Timely planting, careful attention to good seeding technique and using high quality seed are the best management strategies for improving seedling survival rates.

TABLE 3. Key for Selecting the "Best" Legumes to Plant on Hay and Pasture Lands Differing in Soil Drainage, Fertility, and ph Level.

DRAINAGE CONDITION	FERTILITY LEVEL	PH LEVEL	ADAPTED LEGUMES (most to least desirable)*
Good Drainage	High Fertility	pH above 6.5	Alfalfa, Red clover, Trefoil, White clover, Kura clover
		pH below 6.5	Red clover, Trefoil, White clover, Kura clover
	Moderate Fertility	pH above 6.5	Alfalfa, Red clover, Trefoil, White clover, Kura clover
		pH below 6.5	Red clover, Trefoil, White clover, Kura clover
	Low Fertility	pH above 6.5	Red clover, Trefoil, White clover, Kura clover
		pH below 6.5	Red clover, Trefoil, White clover, Lespedeza*
Moderate Drainage	High Fertility	pH above 6.5	Alfalfa, Red clover, Trefoil, White clover, Kura clover
		pH below 6.5	Red, White & Kura clover, Trefoil, Lespedeza*
	Moderate Fertility	pH above 6.5	Alfalfa, Trefoil, Red clover, White clover, Kura clover
		pH below 6.5	Red, white & Kura clover, Lespedeza*
	Low Fertility	pH above 6.5	Red, white & Kura clover, Lespedeza*
		pH below 6.5	Trefoil, White clover, Lespedeza*
Poor Drainage	High Fertility	pH above 6.5	Red clover, Trefoil, White clover
		pH below 6.5	Red clover, White clover, Lespedeza*
	Moderate Fertility	pH above 6.5	Red clover, Trefoil, white clover
		pH below 6.5	Trefoil, White clover, Lespedeza*
	Low Fertility	pH above 6.5	Alsike clover, Trefoil, White clover, Lespedeza
		pH below 6.5	Alsike clover, Trefoil, White clover, Lespedeza

*Lespedeza is generally adapted only to the lower few tiers of counties in Iowa.

TABLE 4. Weight per Bushel, Seeds per Pound, Seeds per Square Foot, and Seeding Rate.

FORAGE CROP	LEGAL WT PER BU (LB)	SEEDS PER LB	SEEDS/SQ FT AT 1 LB/A	SEEDING RATE LB/A[a] ALONE	IN MIXTURE
LEGUMES					
Alfalfa	60	225,000	5.0	10-15	4-12
Alsike clover	60	690,000	15.8	4-6[b]	1-4
Birdsfoot trefoil	60	380,000	8.7	5-8	2-5
Cicer milkvetch	60	135,000	3.1	20-25	10-15
Crownvetch	60	120,000	2.8	8-15	5-10
Hairy vetch	60	20,000	0.5	20-30	10-20
Kura clover	-	-	5-6	8-10	-
Lespedeza (Korean)	40	235,000	5.4	20-25[c]	10-15
Ladino clover	60	800,000	18.4	1-3[b]	¼-1
Mammoth red clover	60	295,000	6.8	8-10	4-8
Medium red clover	60	275,000	6.3	8-12	4-8
Sweetclover	60	260,000	6.0	8-15[c]	4-8
GRASSES					
Kentucky bluegrass	14	2,177,000	50.0	5-10	2-6
Orchardgrass	14	654,000	15.0	8-12	4-6
Annual & Perennial Ryegrass	--	275,000	6.3	15-20	5-10
Redtop	14	4,990,000	114.6	3-6[b]	1-3
Reed canarygrass	46	530,000	12.2	8-12	4-8
Smooth bromegrass	14	136,000	3.1	10-15	4-10
Tall fescue	25	227,000	5.2	8-15	4-8
Timothy	45	1,200,000	27.5	4-8	2-4
Big bluestem		165,000	3.8	10-12[d]	5-6
Indiangrass		175,000	4.0	10-12[d]	5-6
Switchgrass		389,000	8.9	5-7[d]	3-4
Millets		variable	--	20-40	
Sudangrass	32	variable	--	25-30	
Teff		1.3 million	29.8	4-9	

a Use pounds of bulk seed unless specified otherwise. b Not recommended as a pure stand.
c Use scarified seed. d Pounds of pure live seed (PLS). PLS%=(% Germination X % Purity)/100

TABLE 5. Forage Seed Mixture Recommendations (lbs. per acre) Hay crops Moderately to well-drained, limed or nonacid, fertile soils

MODERATELY TO WELL DRAINED, LIMED, OR NONACID, FERTILE SOILS

1. Alfalfa	12-15
2. Red clover	10-12
3. Alfalfa plus	8-10
Smooth bromegrass	6-8
or Orchardgrass	4-6
or Reed canarygrass	6-8
or Timothy	3-4
4. Red clover or Kura clover	8-10
Smooth bromegrass	5-6
Orchardgrass	3-4
or Timothy	3-4

IMPERFECTLY DRAINED, SLIGHTLY ACID SOILS

5. Alfalfa	5-6
Red clover	3-4
Smooth bromegrass	6-8
or Orchardgrass	4-6
or Reed canarygrass	6-8
or Timothy	3-4
6. Red clover plus	6-8
Smooth bromegrass	6-8
or Orchardgrass	4-6
or Reed canarygrass	6-8
or Timothy	4-5

POORLY DRAINED SOILS

7. Red clover	5-7
Alsike clover	2
Orchard grass	4-6
or Reed canarygrass	6-8
or Timothy	3-4
8. Alsike clover plus	4
Reed canarygrass	6-8
or Timothy	4-5
or Tall fescue	6-8
or Redtop	4
9. Birdsfoot trefoil	5-6
Timothy	2-4

DROUGHTY SOILS

10. Alfalfa	8-10
Smooth bromegrass	6-8
or Orchardgrass	4-6
or Tall fescue	6-8

FOR ROTATION AND PERMANENT PASTURES

11. Alfalfa plus	6-8
Smooth bromegrass	6-8
or Orchardgrass	4-6
or Tall fescue	6-8
12. Alfalfa	6-8
Timothy	2-4
Smooth bromegrass	4-6
or Orchardgrass	3-4
For mixtures 11 and 12 you can substitute 4 lbs/A red clover for ½ the alfalfa seeding rate, or 6-8 lbs/A red clover in place of alfalfa.	
13. Smooth bromegrass	15-20

IMPERFECTLY DRAINED SOILS

14. Red clover	6-8
Ladino med or med leaf wt.clov	½
Orchardgrass	4
or Tall fescue	6-8
15. Ladino or med leaf wt. clov	½-1
Orchardgrass	6-8
or Tall fescue	6-8
16. Birdsfood trefoil	5
Tall fescue	6-8
or Timothy	3-4
17. Birdsfoot trefoil	6
Kentucky bluegrass	4-6
18. Smooth bromegrass	15-20
19. Tall fescue	10-15
20. Smooth bromegrass	10
Orchardgrass	4
21. Switchgrass	5-7 PLS
22. Big Bluestem	10-12 PLS

POORLY DRAINED SOILS

23. Birdsfood trefoil plus	5
Orchardgrass	5
or Timothy	3-4
24. Alsike clover	2-4
Ladino or med leaf wt clover	½
Reed canarygrass	8
or Timothy	4
or Tall fescue	8
25. Reed canarygrass	10
26. Tall fescue	10-15
27. Switchgrass	5-7 PLS
28. Ladino or med leaf wt. clov	1-2
Kentucky bluegrass	6-8

DROUGHTY SOILS

29. Alfalfa plus	6-8
Smooth bromegrass	6-8
or Orchardgrass	4-6
or Tall fescue	6-8
30. Smooth bromegrass	15-20
31. Tall fescue	10-15
32. Crownvetch	8-10
Smooth bromegrass	6-8

PASTURE FOR HORSES

33. Alfalfa	6-8
Kentucky bluegrass	2
Smooth bromegrass	6-8
or Orchardgrass	4-5
34. Ladino or med leaf wt clover	½
Kenucky bluegrass	3-5
Timothy	2-4
or Orchardgrass	6
or Smooth bromegrass	6
35. Birdsfoot trefoil	6
Timothy	2

PASTURE FOR HOGS

36. Alfalfa	8
Ladino or med leaf wt clover	2
37. Forage Rape	4-6
Oats	1-2 Bu.

SUPPLEMENTAL PASTURE

38. Sudangrass	25-30
39. Oats	2-3 Bu.
40. Hybrid Pearl Millet	30-35
41. Winter rye (fall planted)	1 ½ Bu.

SUPPLEMENTAL PASTURE continued

42. Foxtail/German Millet	20-25
43. Forage Rape	4-6
Oats	1-2 Bu.

GRASSED WATERWAYS

44. Reed canarygrass	8-12
45. Tall fescue	10-15
46. Smooth bromegrass	15-25

Table 5 provides a list of the most frequently used forage seed mixtures in Iowa. It contains mixtures for specific use situations and those most appropriate for sites where soil drainage or other characteristics may limit success. With each type of grass or legume different varieties are available, each of which has slightly different traits.

A good variety should: be a top yielder, have sufficient winter-hardiness for your location, and be resistant to the array of plant diseases present in your fields. Only a few states provide University Variety trial information for forage varieties. Use information from locations most similar to those of the conditions in which you are growing your crops.

USE GOOD SEEDING MANAGEMENT

Top yields are possible only with thick, vigorous, well-managed stands. Careful attention to seeding practices and seeding year management often makes the difference between profitable, productive stands and failures.

For additional information on forage establishment management, see ISU Extension publications PM856, Improving Pasture by Frost Seeding; PM1008, Steps to Establish and Maintain Legume-Grass Pastures; and PM1097, Interseeding and No-Till Pasture Renovation.

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