

SELECTING FORAGE SPECIES

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) | | PALATABILITY |
|---|-----------------------|--------------------------------|--------|-------------------|------------|--------------|
| | | | | CONTINUOUS | CONTROLLED | |
| 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 | DROUGHT | SOIL WETNESS | 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 | TM | 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 | TM | 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 | | | | | P | Photosensitization (sunburn on animals with light colored hair, reduce animal performance) | | | |
| **Anti-quality components: | | | | | T | Tannins (decrease palatability) | | | |
| A | Alkaloids (decrease palatability) | | | | 1 | Select erect varieties for hay and prostrate varieties for pasture. | | | |
| B | Bloat potential | | | | 2 | Limited to extreme southern Iowa, must be allowed to mature and reseed a stand for the next year. | | | |
| C | Coumarin (hemorrhagic agent, formed during spoilage of hay) | | | | 3 | Select the more winterhardy varieties for use in Iowa. | | | |
| CG | Cyanogenic Glycosides (may form hydrogen cyanide-HCN poisoning; also Prussic Acid Poisoning) | | | | 4 | Select the low-alkaloid varieties to improve palatability. | | | |
| ET | Endophyte Toxicity (reduce blood circulation to appendages "dry gangrene") (variety dependent) | | | | 5 | Select the endophyte-free varieties to improve animal performance. | | | |
| G | Glycosides (decrease palatability) | | | | | | | | |

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 |
| Millet | | 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. Birdsfoot 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. Birdsfoot 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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...and justice for all

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