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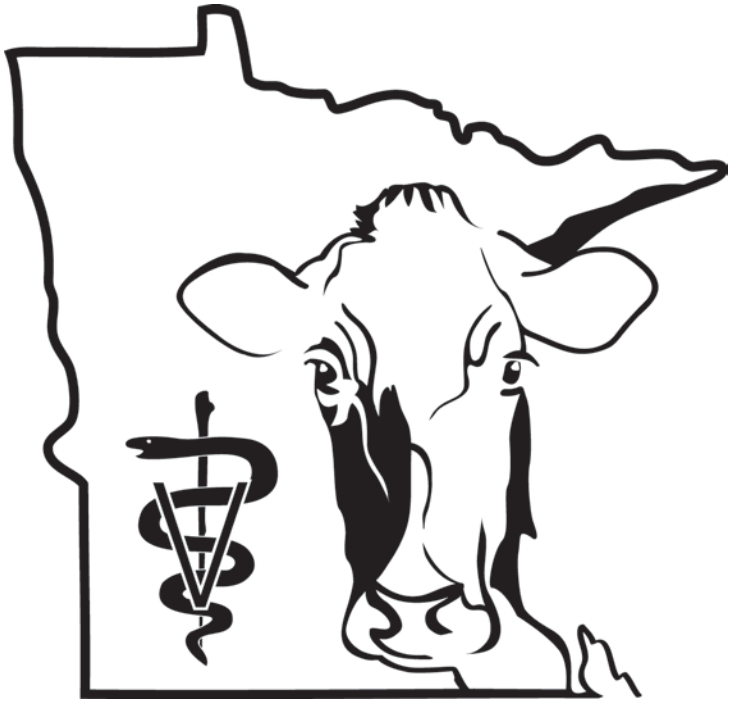

ST. PAUL, MINNESOTA
UNITED STATES OF MINNESOTA

PROS AND CONS OF CORN, LEGUMES, AND GRASSES

Craig Sheaffer
Department of Agronomy and Plant Genetics
University of Minnesota

There are several forages suitable for livestock feeding. Selection must be based on consideration of nutrient needs of livestock and costs of purchase or production. In selection of forages to grow, consideration must also be given to the soil conditions, contribution to the cropping system, and method of utilization. Productive forage systems utilize perennial legumes and grasses in combination with annual species. Species should be selected which compliment each other.

Legumes (*Leguminosae*) and grasses (*Graminae*) are the two major plant families used for forage. Legumes are plants which bear seeds in pods and if properly managed, legumes can convert atmospheric nitrogen into nutritionally valuable plant protein. This process is called symbiotic nitrogen fixation. Legumes vary in their capacity to conduct nitrogen fixation, but the result of nitrogen fixation is that legume forage and seed is consistently rich in protein and that legumes require no nitrogen fertilizer. Legumes are less well adapted to extremes in soil and climatic conditions and to poor management than grasses but species can be selected which grow better under some conditions. Nutritionally, forage of legumes tends to have higher protein concentration, greater rates of digestion, and greater intake potential than forage of grasses.

Grasses are a very large family of plants which include cereal crops such as corn and small grains as well as the forage grasses such as quackgrass and smooth bromegrass. Annual grasses can provide high energy grain in addition to forages. For productive grass production, nitrogen inputs are required.

Perennial forage crops

Perennial small seeded legumes and grasses grown in swards are well know as soil building plants. They provide greater cover and provide greater erosion control than row crops. They also contribute significant amounts of soil organic matter which enhances soil tilth and earthworm populations.

Several perennial grasses have good forage yield, forage quality, and persistence. Traditionally, smooth bromegrass and timothy have been used in mixtures with legumes for hay and pasture. Low alkaloid reed canarygrass has great potential as a forage grass because of it adaption to wet and dry soils and because of its tolerance to frequent cutting. Quackgrass which is often considered a weed has forage yield and quality similar to other perennial grasses.

Alfalfa is among the most productive and widely grown perennial legumes, but for profitable alfalfa production use of insecticides and fertilizers is required. Alternatives to alfalfa on wet or low pH soils include birdsfoot trefoil and red clover. Birdsfoot trefoil is especially valuable as a grazing legume because it is non-bloating and contains by-pass protein. Kura clover is the only legume with good long-term persistence.

Annual crops

Annual crops such as small grains, sorghums, and corn are often used for silage production and sometimes for hay. Dent corn is the most widely grown crop because of its' high yields of energy and dry matter. Other crops like sorghum also have high potential dry matter yields but quality is usually lower than for dent corn. For multiple cutting or grazing, pearl millet, sudangrass, or sorghum-sudangrass offer the best combination of yield and forage quality.

Barley has several attributes that make it desirable as a forage. These include high nutritive value and lower fiber content than other small grains. 'Royal' is the first short-stature barley especially developed for use as a forage crop in Minnesota.

Annual legumes such as field peas, cowpeas, and soybeans can also be grown as protein sources. These are usually grown in association with annual grasses.

References

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Table 1. Forage yield and quality of annual forages.

Species	Yield		Quality	
	DM	CP	NDF	IVDDM
	T/A	% of dry weight		
Dent corn	8.1	6.8	43.6	68.2
Sorghum	8.8	5.8	49.4	61.5
Popcorn	5.3	7.2	51.2	64.4
Sweetcorn	4.9	8	49.3	68.1
Multiple cuts				
Typhon	3.1	15.4	27	75
Alfalfa	3.4	20.1	39	64.2
Red Clover	3.7	19.5	39.9	64.9
Sudangrass	5.7	12.7	58.6	61.0
Sorg-Sud	5.9	11.9	58.6	61.5
Sorg+Soybean	5.3	12.2	57.5	61.9
Proso millet	2.3	18.8	56.2	66.7
Foxtail millet	3.2	17.4	57.8	63.9
Pearl millet	5.8	19.2	58.4	65.4
Japanese millet	5	18.6	60.4	55.8
Sudangrass	6.2	19.2	59.6	62.9
Sorg-sudangrass	5.8	19.5	58.9	65.0
Single cut				
Field pea	1.5	15.1	42.3	61.7
Cowpea	2.4	13.6	31.9	67.0
White lupine	1.3	12.9	47.8	63.0
Field pea + oats	2.1	9.5	58.8	52.9
Triticale + peas	1.5	14.5	52.2	59.6
Oat @ boot	1.6	20.5	NA	77.6
Oat @ milk	3.0	14.6	NA	66.4
Barley @ boot	1.7	23.4	NA	81.3
Barley @ milk	3.2	15.7	NA	68.5
Triticale @ boot	1.7	22.2	NA	79.6
Triticale @ milk	3.0	15.2	NA	66.4
Soybean	3.3	18.7	44.2	61.1
Milo + soybeans	4.1	12.1	56.4	55.8
Proso millet	3.0	13.0	62.1	62.4
Foxtail millet	3.5	12.3	65.5	58.1
Pearl millet	5.4	11.6	66.5	58.9
Japanese millet	3.5	13.9	64.5	60.9
Sudangrass	6.2	10.4	66.7	58.7
Sorgh-sudangrass	7.3	9.6	67.8	58.8

Source: N.D. Martin, 1996.

Table 2. Characteristics of perennial cool season grasses.

Grass	Heat/drought Tolerance	Flooding Tolerance	Winterhardiness	Frequent cutting Tolerance	Seedling Vigor	Sod-forming Capacity
Reed canarygrass	E	E	E	E	F	E
Smooth bromegrass	E	F	E	P	E	E
Orchardgrass	G	P	F	E	E	P
Tall Fescue	E	P	F	E	E	F
Timothy	P	P	E	P	F	P
Perennial Ryegrass	P	P	P	E	E	P
Kentucky bluegrass	P	F	E	E	F	E

E = excellent, G = good, F = fair, P = poor

Table 3. Characteristics of forage legumes[a].

Legume	Tolerance to							Seeding vigor	Ruminant bloat inducing
	Heat/ drought	Wet	Winter hardiness	Frequent cutting/ grazing	Soil Salinity	Soil acidity	Soil alkalinity		
Alfalfa	E	P	E	G	F	P	F	F	Yes
Alsike clover	P	E	P	P	F	G	G	G	Yes
Birdsfoot trefoil	F	E	F	G	F	G	G	P	No
Cicer milkvetch	G	F	E	F	F	F	E	P	No
Crownvetch	G	P	P	P	F	G	P	P	No
Kura clover	F	G	E	E	F	F	F	P	Yes
Red clover	F	F	F	F	F	F	P	E	Yes
Sainfoin	E	P	E	P	P	P	E	F	No
Sweetclover	E	P	E	P	G	P	E	G	Yes
White clover	P	F	P	G	F	F	P	F	Yes

[a]E = excellent, G = good, F = fair, P = poor.

Table 4. Forage yield and stand persistence (percent ground cover) of perennial grasses with first cut at seed (two cuts per year, 60 days between cuttings, heading (three cuts per year, 45 days between cuttings) and vegetative (four cuts per year, 30 days between cuttings) stages in southern Minnesota (St. Paul).[1]

Grass	Forage Yield (tons/acre)[2]			Grass Stand (%)		
	2-cut	3-cut	4-cut	2-cut	3-cut	4-cut
Baylor smooth bromegrass	6.6	5.0	4.5	83	50	45
Orion orchardgrass	5.9	5.7	4.8	55	95	77
Rise reed canarygrass	6.4	6.0	5.0	95	88	68
Venture reed canarygrass	6.6	5.6	4.9	95	90	79
Palaton reed canarygrass	6.3	6.0	5.6	93	88	82
LSD (0.05)[3]	0.8			11		

[1]Sheaffer et al., 1990. Journal of Production Agriculture.

[2]Yield values averaged for three years. Stand persistence measured in the spring following three years of harvesting. Grasses fertilized with 150 lb N/acre in the spring of each year.

[3]LSD: for statistical separation of all means within yield and stand categories.

Table 5. Forage quality of perennial grasses cut at seed (two cuts per year; 60 days between cuttings), heading (three cuts per year; 45 days between cuttings) and vegetative (four cuts per year; 30 days between cuttings) stages in southern Minnesota (St. Paul).[1,2,3]

Grass	2-cut management (%)			3-cut management (%)			4-cut management (%)		
	CP	NDF	DDM	CP	NDF	DDM	CP	NDF	DDM
Baylor smooth bromegrass	10.8	62.9	54.8	13.5	59.9	60.8	17.9	52.6	69.8
Orion orchardgrass	11.7	61.7	58.7	13.4	57.7	66.4	16.8	52.6	70.6
Rise reed canarygrass	12.6	61.7	54.2	14.6	59.9	58.0	18.1	54.6	65.9
Venture reed canarygrass	11.9	62.8	52.5	13.2	61.8	57.8	18.4	54.0	66.8
Palaton reed canarygrass	12.9	61.4	54.8	13.6	60.1	59.1	18.4	54.3	66.4
LSD (0.05)[4]	1.2	1.9	2.3						

[1]Sheaffer et al., 1990. Journal of Production Agriculture.
[2]Grasses fertilized with 150 lb N/acre in the spring.
[3]CP = crude protein; NDF = neutral detergent fiber; DDM = digestible dry matter.
[4]LSD: for statistical separation of CP, NDF, and DDM means within and over cutting managements.

Table 6. Effect of cutting schedules on forage yield (tons per acre) and final stands (percent) of perennial forage legumes at Lamberton, Minnesota.

Cut/year[a]	Legume[b]	Forage yield 1987	1988	1989[c]	3-yr total	Stand[c]
2-cuts	Alfalfa	5.4	4.1	3.2	12.7 (100)[d]	90
	White clover	2.1	0.4	---	2.5 (20)	53
	Alsike clover	3.5	---	---	3.5 (28)	---
	Red clover	4.8	2.4	1.1	8.3 (65)	36
	Crownvetch	3.9	2.9	1.5	8.3 (65)	69
	Cicer milkvetch	4.9	3.2	2.2	10.3 (81)	88
	Birdsfoot trefoil	5.6	3.4	2.1	11.1 (87)	86
	LSD (0.05)	0.7	0.5	0.4		21
3-cuts	Alfalfa	6.1	4.8	2.6	13.5 (100)	92
	White clover	2.2	0.3	---	2.5 (18)	50
	Alsike clover	3.1	---	---	3.1 (23)	---
	Red clover	5.8	2.4	1.1	9.3 (69)	50
	Crownvetch	3.3	2.0	0.9	6.2 (46)	87
	Cicer milkvetch	3.9	2.4	1.5	7.8 (58)	89
	Birdsfoot trefoil	5.3	3.1	1.5	9.9 (73)	91
	LSD (0.05)	0.6	0.4	0.3		8
4-cuts	Alfalfa	6.3	4.5	3.1	13.9 (100)	92
	White clover	2.5	0.4	---	2.9 (21)	43
	Alsike clover	2.7	---	---	2.7 (19)	---
	Red clover	5.2	2.1	1.2	8.5 (61)	65
	Crownvetch	2.7	1.3	0.9	4.9 (35)	79
	Cicer milkvetch	2.8	1.6	1.2	5.6 (40)	85
	Birdsfoot trefoil	4.8	1.9	1.4	8.1 (58)	95
	LSD (0.05)	0.7	0.4	0.6		22

[a]Cut/yr: 2-cuts at full flower (June 15, August 24); 3-cuts at bud-early flower (June 5, July 15, September 1); 4-cuts at vegetative-bud (May 28, June 26, July 27, September 1).

[b]'DK-120' alfalfa, 'Common' alsike, 'Arlington' red clover, 'Penngift' crownvetch, 'Monarch' cicer milkvetch, 'Norcen' birdsfoot trefoil, 'Sacramento' ladino clover.

[c]Forage yields from a harvest of all plots in early June; final stands estimated in May 1989.

[d]Values in parenthesis are percentage of alfalfa total yield for each cutting schedule.

Table 7. Effect of cutting schedules on average seasonal forage crude protein (CP), in vitro digestible dry matter (IVDDM), and neutral detergent fiber (NDF) concentration of perennial legumes at Lamberton, Minnesota.

Cuts[a]	Legume[b]	Percent dry weight		
		CP	IVDDM	NDF
2-cut	Alfalfa	14.3	57.9	50.7
	Alsike clover	17.1	62.9	42.0
	Red clover	15.4	60.1	47.7
	Crownvetch	16.8	64.3	41.0
	Cicer milkvetch	16.5	62.5	40.1
	Birdsfoot trefoil	15.7	58.9	48.5
	White clover	19.9	65.8	35.7
	LSD (0.05)	1.0	1.4	2.1
3-cut	Alfalfa	17.1	62.2	43.4
	Alsike clover	21.5	69.1	31.2
	Red clover	18.8	64.5	40.2
	Crownvetch	20.5	66.2	35.9
	Cicer milkvetch	20.0	64.9	35.0
	Birdsfoot trefoil	20.1	63.0	37.7
	White clover	20.6	65.4	35.0
	LSD (0.05)	2.0	2.0	3.5
4-cut	Alfalfa	20.3	62.5	42.0
	Alsike clover	24.4	70.1	28.9
	Red clover	21.9	64.9	39.7
	Crownvetch	23.6	68.6	32.3
	Cicer milkvetch	22.9	66.6	32.1
	Birdsfoot trefoil	22.5	64.4	38.2
	White clover	23.4	67.5	31.1
	LSD (0.05)	0.9	1.4	2.1

[a]Cut/yr: 2-cuts at full flower (June 15, August 24); 3-cuts at bud-early flower (June 5, July 15, September 1); 4-cuts at vegetative-bud (May 28, June 26, July 27, September 1).
[b]'DK-120' alfalfa, 'Common' alsike, 'Arlington' red clover, 'Penngift' crownvetch, 'Monarch' cicer milkvetch, 'Norcen' birdsfoot trefoil, 'Sacramento' ladino clover.