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Annual Cover Crop Options

for Grazing in the Northern Plains

The purpose of this publication is to provide annual forage options that can be used for livestock grazing and/or harvested feeds.

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The use of cover crops in a cropping rotation or as an integrated livestock-cropping system has become a popular option for farmers. The value of cover crops to the environment and our knowledge of their usefulness continues to grow.

Although cover crops have been used for centuries, farmers and ranchers today have become more aware of management strategies to reduce soil erosion, improve soil biodiversity, increase soil nutrient retention and promote soil water-holding capacity.

Cover crops may provide opportunities to use cropped land for grazing livestock or to produce a harvested feed source. Livestock grazing of cover crops can further recycle nutrients back into the soil. Harvested cover crops for hay, haylage and silage; when harvested at the correct time, can provide a nutrient-rich winter feed.

A whole-systems approach:

Resource objectives and concerns should be identified before utilizing cover crops in a livestock grazing system so that an appropriate cover crop mix can be determined.

Some examples of resource concerns are: soil health, weed problems, field water stress and livestock dry lot management.

Photo by Kevin Sedivec, NDSU Extension

Types of Forages Species

Many annual forage species can provide excellent grazing opportunities for livestock or as harvested feeds. However, with the relatively short growing season of 110 to 150 days in the northern Plains, limitations occur for many species. This is especially true when developing forage mixtures for planned late- and early season grazing periods. When growing a forage to be harvested mechanically, seeding should occur in late spring to early summer for planned summer harvest and in September for winter cereals to be harvested the subsequent year for planned early summer harvest.

One fact to be aware of is that **cool-season crops** can be seeded in the spring (April - June) and summer (July - August) months, while **warm-season crops** need to be seeded late spring through midsummer (May - July).

Photo by Kevin Sedivec

Pasja Turnip

Photo by Marisol Berti

Sorghum-Sudan Hybrid

Cover Crop and Annual Forage Species

Cool-season

Cereal Grains	Broadleaf	Legumes
Oats (grain, forage)	Purple top turnip (Brassica)	Field peas
Barley (grain, forage)	Pasja turnip (Brassica)	Forage peas
Wheat (spring, winter)	Radish (Brassica)	Hairy vetch
Triticale (spring, winter)	Kale (Brassica)	Lentils
Rye (cereal, winter)	Canola (Brassica)	Berseem clover
	Red clover	Sweetclover
	Swede (Brassica)	Winter peas
	Camelina (Brassica)	Common vetch
	Flax	Faba beans
	Sugarbeets	

Warm-season

Grasses	Broadleaf	Legumes
Foxtail millet	Sunflowers	Soybeans (grain or forage variety)
Japanese millet	Buckwheat	Chickpeas
Pearl millet	Amaranth	Mung beans
Sudangrass	Safflowers	Cowpeas
Sorghum		Sunnhemp
Sorghum-sudangrass		
Corn		
Teff		

Establishment of Cover Crops

Establishment of a cover crop requires a relatively weed-free seedbed and good seed-to-soil contact, similar to planting other crops. Drilling the seed in will provide better establishment than broadcasting it.

Fall cover crop seed can be applied aerially onto standing corn or soybeans as they are drying down and enough sunlight can penetrate the ground between the rows. Aerial seeding only works for small seeds (turnip, radish, rye, etc.) and yet the success of establishment will depend on rainfall after seeding.

Interseeding between rows at the V4 to V6 stage also has been performed successfully, whereas seeding at V6 or later does not provide much forage growth. Regardless of timing, if moisture is limited, plant growth is limited to nonexistent. Thus, in dry years, aerial seeding and interseeding are not cost-effective.

Recommended seeding rates, depths and dates for each cover crop also must be considered when planning to integrate cover crops into an operation **(Table 1)**. Cover crops for late-season grazing should be seeded no later than Aug. 1 to be cost-effective in the northern Plains so young plants have time to develop prior to frost.

Be aware of herbicide carryover if the field has been burned down or sprayed chemically due to sensitivity issues for some cover crop species. Some herbicides may have residual effects that inhibit cover crop growth.

Table 2 (Page 6) summarizes the risk of cover crop injury for common herbicides used in North Dakota. Herbicide carryover is a function of the chemicals half-life and is influenced by sunlight, moisture and soil properties. If you are planning on grazing, check the label for grazing restrictions.

Table 1. Recommended seeding rates based on single crop use and four- to five-way mixture for selected cover crop species.

CROP/VARIETY	FAMILY	SEASON	SEEDING RATE DRILLING	SEEDING RATE BROADCAST	SEEDING RATE IN A 4- TO 5-WAY MIX
			(LBS/A PLS)	(LBS/A PLS)	(LBS/A PLS)
SELECT ONE	-	-	-	-	-
ANNUAL RYEGRASS (CRUSADER)	Cereals	Cool	12	13-22	4-6
BERSEEM CLOVER	Legume	Cool	8-15	no broadcast	2-5
BUCKWHEAT	Broadleaf crops	Warm	20-35	no broadcast	2-5
CHICKPEAS	Legume	Warm	80-100	no broadcast	10-15
CHICORY	Broadleaf crops	Warm	4-6		1
CONVENTIONAL BARLEY	Cereals	Cool	50-75	55-83	10-15
CONVENTIONAL OATS	Cereals	Cool	30-60	33-66	10-15
CONVENTIONAL SOYBEANS	Legume	Warm	30-40	no broadcast	10-15
COW PEAS	Legume	Warm	30-90	no broadcast	10-15
CRIMSON CLOVER	Legume	Cool	10-20	11-22	2-5
ETHIOPIAN CABBAGE	Brassica	Cool	3-4	4	1
FABA BEANS	Legume	Cool	60-80	no broadcast	5-20
FIELD PEAS	Legume	Cool	30-50	no broadcast	10-15
FORAGE BARLEY	Cereals	Cool	50-75	55-83	10-15
FORAGE CORN	Grasses	Warm	25-30	no broadcast	10-15

Table 1 continues on Page 5

CROP/VARIETY	FAMILY	SEASON	SEEDING RATE DRILLING	SEEDING RATE BROADCAST	SEEDING RATE IN A 4- TO 5-WAY MIX
			(LBS/A PLS)	(LBS/A PLS)	(LBS/A PLS)
FORAGE OATS	Cereals	Cool	30-60	33-66	10-15
FORAGE PEAS	Legume	Cool	30-50	no broadcast	10-15
FORAGE RAPE	Brassica	Cool	2-5	2.2-5.5	1
FORAGE SORGHUM (BMR)	Grasses	Warm	8-12	no broadcast	2-5
FORAGE SOYBEANS	Legume	Warm	30-40	no broadcast	10-15
GERMAN MILLET	Grasses	Warm	10-15		2-4
GRAIN SORGHUM	Grasses	Warm	8-12	no broadcast	2-5
GRAZA RADISH	Brassica	Cool	5-7		3
HAIRY VETCH	Legume	Cool	15-20	17-22	5-10
JAPANESE MILLET	Grasses	Warm	12-15	13-17	2-4
KALE	Brassica	Cool	3-4	4	1
LENTILS	Legume	Cool	30-80	no broadcast	5-10
NEW YORK WINTER TURNIP	Brassica	Cool	3		1
PASJA TURNIP	Brassica	Cool	1-3	1.1-3.3	1
PEARL MILLET	Grasses	Warm	10-15	11-17	2-4
PHACELIA	Legume	Warm	3.5	7	2-5
PLANTAIN	Broadleaf crops	Cool	3-8		1-2
PROSO MILLET	Grasses	Warm	10-15		2-4
PURPLE TOP TURNIP	Brassica	Cool	1-3	1.1-3.3	1
RADISH	Brassica	Cool	4-8	4	2
RED CLOVER	Legume	Cool	8-10	9-11	2-5
SIBERIAN MILLET	Grasses	Warm	4-12		2-4
SORGHUM/SUDAN BMR	Grasses	Warm	10-15	no broadcast	2-5
SORGHUM/SUDAN NON-BMR	Grasses	Warm	10-15	no broadcast	2-5
SUDANGRASS	Grasses	Warm	10-15	no broadcast	2-5
SUGARBEETS	Brassica	Cool	1-2		1
SUNFLOWERS	Broadleaf crops	Warm		no broadcast	1-2
SUNNHEMP	Legume	Warm	10-15	15-18	5-8
SWEDE	Brassica	Cool	1-3	4	1
SWEETCLOVER	Legume	Cool	6-10	7-11	2-5
SWEETCLOVER	Legume	Cool	10-15		12-5
TEFF	Cereals	Warm	4-8		1
TRITICALE	Cereals	Cool	50-90	55-99	10-15
WINFRED HYBRID	Brassica	Cool	3-4	1.1-3.3	1
WINTER CAMELINA	Brassica	Winter	4-6	8-10	2-5
WINTER CANOLA	Brassica	Cool	2-5	2.2-5.5	1
WINTER RYE	Cereals	Winter	40-90	55-99	10-15
WINTER TRITICALE	Cereals	Winter	50-90	55-99	10-15
WINTER WHEAT	Cereals	Winter	50-90	55-99	10-15

Table 2. Risk of cover crop injury based on highest damage in North Dakota studies.

Herbicide	Radish	Turnip	Field Peas	Lentils	Flax	Oats	Barley	Rape-seed	Dwarf Essex Rape
Clarity	MR	HR	LR	MR	MR	LR	MR		MR
Dicamba	MR	HR	LR	MR	MR	LR	MR		MR
Everest	MR	MR	LR	MR	LR	LR	LR		MR
Flexstar*	HR	LR	LR		LR		LR		
Goldsky	MR	MR	LR	LR	MR	LR	LR		LR
Huskie	LR	LR	LR	LR	MR	LR	LR		MR
PowerFlex	LR	LR	LR	MR	MR	LR	LR		MR
Pursuit*	LR	LR	LR		LR	LR	LR		
Quelex	MR	MR	LR	LR	LR	LR	LR		LR
Raptor*	HR	HR	LR		HR		LR		
Sencor*	MR	MR	LR		LR		LR		
Spartan*	HR	MR	LR	MR	LR	MR	LR	MR	
Supremacy	LR	LR	LR	LR	LR	LR	LR		LR
Valor*	HR	HR	LR	LR	LR		LR	HR	
Varro	MR	LR	LR	LR	LR	LR	MR		LR
WideMatch	MR	MR	HR	HR	LR	LR	LR		MR
Zidua*	MR		LR		LR	MR	LR	MR	
2,4-D	MR	LR	LR	LR	LR	LR	LR		MR

Key: LR – low risk, 0% to 20% injury; MR – medium risk, 21% to 50% injury; HR – high risk, 51% to 100% injury; strike through – severe injury.
*Indicated when fall seeded following crop

Adapted from the 2020 North Dakota Weed Management Guide

The following sections are divided into yearly appropriate times for establishing cover crops and season of use for grazing and/or haying applications

Annual Cover Crop Grazing Options

Selecting a cover crop forage or mixture of forages for grazing livestock will depend on the season of use for optimal performance, seed availability and cost. For the full-season grazing period, we recommend a mixture of cool- and warm-season grasses, broadleaf crops and legume species. This type of mixture will 1) create diversity, 2) minimize risk due to weather conditions, 3) extend the grazing period due to different growth stages and 4) increase soil health benefits.

Matching the proper forage species with the season of use is critical to optimize forage production potential. Reduce seed costs by avoiding low-production plant species while providing high-quality feed.

Fall Seeded

Cover Crops for Spring Grazing

Spring grazing options require preplanning eight to 12 months prior to forage utilization. The most common options are winter cereal crops planted in the fall. Winter cereal options include winter wheat, winter rye and winter triticale.

A winter annual such as hairy vetch or biennials such as sweetclover may be incorporated into a cereal crop seed mixture to enhance soil health benefits and plant diversity in the forage system while providing an additional source of protein and energy for grazing livestock. We recommend caution with hairy vetch due to its potential to survive for many years after seeding and become a nuisance weed in subsequent cash crops.

So which winter cereal crop should you use? Select cereal grain types based on **goals** for the **land, grazing needs, crop insurance guidelines and herbicide carryover** (if applicable). If the goal is to graze the winter cereal crop the subsequent spring, winter triticale provides the most palatable feed type, while winter rye is the most winter hardy but less palatable.

In recent years, winter triticale seed has been the least cost effective, while winter rye the most cost effective **(Table 1)**. Winter wheat is a highly palatable winter cereal but is the least winter hardy; however, new varieties that increase winter hardiness are showing great promise.

Similarly, winter triticale varieties may have poor winter survival, especially in eastern North Dakota. Thoughtful planning of early spring grazing or earlier season haying must be considered when choosing a cereal grain type or mix.

Spring grazing of cereal varieties should occur at the optimum stage of plant development for animal nutritional requirements. The cereal grains below **(Table 3)** were harvested at the early to midflowering stage of production and measured for quality. Comparisons can be made for livestock nutrition, production of biomass, hardiness, competitiveness with weeds and cost.

Using winter-hardy varieties to improve the success of establishing a viable forage crop is critical.

Spring Seeded

Cover Crops for Summer Grazing and Haying

(mid-July to early September)

Cover crops and annual forages make excellent feedstuffs for grazing or haying during the summer season. Often, the development of a summer-season forage crop in North Dakota dedicates land use for an annual single-crop system. Forage species selected for summer use will vary, depending on intended practice.

Although most forage species will fit a grazing program, some are better than others. In comparison, some broadleaf forages are not recommended for baled feed due to high moisture content **(Table 4, Page 8)**. In some operations, dual use of a cover crop is preferred, with haying followed by grazing or vice versa if sufficient regrowth provides full use of the resource.

Table 3. Winter cereal grain trait comparisons.

Winter Cereal Type[1]	Palatability	Nutritional Content[2]		Forage Production	Allopathic Effect on Other Crops[3]	Weed Control	Hardiness and Disease Resistance	Cost
		CP	TDN					
		%	%					
Winter wheat[3]	+	13.5	58.2	0	0	0	–	0
Winter rye[4]	–	12.4	55.9	+	–	+	+	+
Winter triticale	0	13.6	57.6	+	0	0	0	–

[1] Symbols represent neutral (0), advantage (+) or disadvantage (–) when comparing cereal types.

[2] Data from the NDSU Carrington Research Extension Center 2012 Annual Report. CP = crude protein; TDN = total digestible nutrients.

[3] Willow Creek is a winter wheat forage variety developed at Montana State University that has shown superior winter hardiness and production, compared with grain varieties in precipitation zones greater than 16 inches.

[4] Winter rye has been shown to have allopathic (negative chemical) effects on some crops immediately following it in a rotation, but information to this point remains unproven.

Table 4. Rating common forage and grain crops grown in an annual cover crop mixture for livestock grazing and/or harvested feed (+ = a good option value, 0 = a neutral value, – = as a poor option).

Forage Type	Grazing	Hay	Hay Followed by Grazing	Haylage/Baleage/Silage Followed by Grazing
Spring cereal crops	+	+	+	+
Foxtail millet	0	+	–	–
Brassicas	+	–	–	+
Sudangrass	+	+	+	+
Sorghum	–	0	–	+
Sorghum-sudangrass	+	+	+	+
Pearl millet	+	+	+	+
Japanese millet	0	+	0	0
Sunflowers	0	–	–	–
Buckwheat	–	–	–	–
Forage/field peas	+	+	+	0
Cow peas	+	–	–	–
Chickpeas	+	–	–	–
Hairy vetch	0	+	+	0
Lentils	0	–	–	–
Soybeans	0	–	–	–
Berseem clover	+	+	+	0
Sweetclover	+	+	+	0
Flax	–	–	–	–

Harvesting the first crop for hay, which will be followed by regrowth grazing.

(NDSU photo)

Summer Seeded

Cover Crops for Late-season Grazing

(mid-September to mid-January)

Cover crops for late-season grazing can provide significant cost savings to producers by minimizing the need for baled forages. Brassica varieties will dominate this season due to their remarkable forage quality, even after a killing frost **(Table 5)**. We recommend that these mixes include a source of fiber such as a cereal or grass. Introduce livestock slowly and allow them to adjust to a fall cover crop mixture that may be nutrient-rich in comparison with late-summer range.

Late-season grazing of cover crops can be part of a dual-crop system in which a grain, other cash crop or hay crop can be planted beforehand in the spring, followed by the cover crop.

Late-season grazing of cover crops in North Dakota

(Photo by Kevin Sedivec)

Table 5. Cover crop forage quality (seeded in late July/early August) by species for late-season grazing. (Typically, these species are grown in mixtures so values below would be a contribution of each crop to the mixture.)

Late-season crop	Nutritional Content Pre-freeze				Nutritional Content Post-freeze[1]			
	CP[2]	IVDMD[3]	Ca[4]	P[5]	CP %	IVDMD	Ca	P
Cowpeas[6]	15.3	80.1	2.36	0.49	7.3	45.1	1.09	0.26
Radish[9]	16.4	89.1	3.49	0.41	15.9	84.8	2.56	0.40
Soybeans[7]	14.2	75.1	1.48	0.37	11.0	59.2	1.24	0.28
Sunflowers[9]	12.2	75.4	1.58	0.35	7.8	62.9	1.11	0.25
Foxtail millet[6]	9.0	70.1	0.34	0.28	8.4	64.0	0.43	0.29
Turnip[9]	14.6	88.6	3.11	0.42	14.3	83.6	3.37	0.37
Sorghum/sudan[8]	13.3	79.5	1.01	0.35	13.1	69.8	0.85	0.27
Triticale[6]	14.8	81.1	0.56	0.38	12.3	77.2	0.29	0.32
Hairy vetch[6]	17.6	63.2	1.59	0.31	14.4	63.9	0.80	0.34
Barley[6]	15.3	71.0	0.59	0.40	12.5	69.1	0.57	0.31
Oats[6]	15.1	79.0	0.32	0.38	7.0	70.7	0.26	0.23

[1] Freeze is defined as an extended period of at least two hours at or below 28 F air temperature. Average air temperatures were obtained through NDAWN (North Dakota Agricultural Weather Network). Samples were averaged from two collection periods post-freeze.

[2] CP = crude protein.

[3] IVDMD = In vitro dry matter digestibility - the measure of actual feed digestibility based on the amount of dried matter that is digested in a solution of rumen fluid. IVDMD is an actual measurement, while TDN, which also is used to measure digestibility, is a calculated measurement.

[4] Ca = calcium/

[5] P = phosphorus.

[6] Based on one year's data on trials from the Central Grasslands Research Extension Center.

[7] Based on two years' data on trials from the Central Grasslands Research Extension Center.

[8] Based on three years' data on trials from the Central Grasslands Research Extension Center.

[9] Based on four years' data on trials from the Central Grasslands Research Extension Center.

Cover crop grazing in dual-crop system

(Photo by Tim Becker, NDSU)

Producers need to keep in mind that cover crops planted in mid to late summer are precipitation-dependent and success will be possible only with adequate rainfall to replenish the topsoil.

The second crop in the dual-cropping system (cover crop) also will use water reserves found in the subsoil and can impact growth and yield of the subsequent year's crop if spring and summer moisture conditions are poor.

Cover crops for late-season grazing should be seeded no later than Aug. 15 to be cost effective in the northern Plains. Warm-season crops also will have limited value if seeded after Aug. 1 due to the short growing season that remains. The cover crop can be seeded after the grain or hay crop is removed.

If the first crop is intended to be harvested for hay, haylage or silage, you can seed the cover crop with the first crop. Once you harvest the first crop, the second crop already will be established but short in stature.

The cover crop, with the exception of legumes, will grow rapidly once the first crop is removed and moisture is plentiful. Make sure to check Risk Management Agency guidelines to ensure your first crop (for example, corn) that is planned for haylage or silage qualifies for crop insurance if a second crop is planted with the first crop.

Annual Cover Crop Livestock Grazing Considerations

The following points should be considered when grazing certain types of cover crops for the best animal performance.

Observation and management of cover crop grazing can ensure that animals have their nutritional needs met while also recycling cover crop nutrients for enhanced soil benefits.

Nitrate toxicity

Cereal grain crops, forage corn, brassicas, and pearl and Japanese millet should be sampled and tested for nitrate levels before livestock are turned out to graze, especially when the plant is stressed from droughty conditions. In addition, oats and peas that often may be seeded together and harvested as hay or haylage can provide grazeable regrowth. This regrowth should be tested for nitrate toxicity because oats can be a nitrate accumulator.

Brassica considerations

Brassicas are plants in the mustard family that include turnips and radishes. They often are planted as cover crops for soil health benefits, with an additional high grazing value. These plants are high in water and very digestible, so they should be seeded in a mixture or grazed with free-choice hay or straw to slow the passage of nutrients in the grazing animal. Brassicas also can be high in glucosinolates, which can cause thyroid problems in grazing cattle if fed alone; this is another reason for utilizing them in a mix with other annual crops. Brassicas also can become high in nitrates under drought-induced stressful conditions or if nitrogen already is present in the soil (for example, through manure spreading). Some brassica stands in North Dakota have tested high for nitrates; therefore, testing always is recommended.

Prussic acid toxicity

Sorghum, sudangrass or sorghum-sudangrass are susceptible to prussic acid toxicity during or directly following a frost. Prussic acid testing can be done but it is limited and can be challenging; therefore, awareness of the potential for poisoning is key. Do not graze livestock on immature growth or regrowth below 18 inches following haying or grazing nor immediately after a light frost or hail injury. After a hard frost, wait for seven to 10 days before turning livestock out onto regrowth and six days before turning them out on mature growth. Check with your local Extension agent for more information.

Sweetclover poisoning

Sweet-clover harvested at high moisture (greater than 20%) for hay, haylage, baleage and silage may mold. Coumarin is a compound present in sweetclover and it is converted to dicoumarol by mold. This toxic compound prevents normal blood clotting, resulting in hemorrhages and associated symptoms. Avoid feeding cows bales of sweetclover left to overwinter because they likely will contain high levels of dicoumarol.

Oilseed inclusion

Mature flax (with seeds), sunflowers or any oilseed containing mature seeds should be limited to 12% of a livestock diet (dry matter) or less because of its high fat content. Excessive fat (more than 5% fat) in ruminant diets can impair the livestock's ability to digest forages normally. Flax residue can cause impaction if consumed in large quantities.

Field management

Dividing a field into sections based on the stocking rate and degree of utilization of cover crop can maximize grazing efficiency while improving nutrient distribution of livestock manure. For more information on determining forage production and setting stocking rates, refer to the following NDSU Extension publications: *"NDSU Extension Range and Forage Production Sample Kits"* and *"Determining Carrying Capacity and Stocking Rates for Range and Pasture in North Dakota."*

Annual Cover Crop Haying Options

Hay baled for later forage options should focus on maximizing yield and quality. Hay should include a mix of grass and legumes, or a single species that can be harvested at the correct time to potentially meet an animal's protein and energy requirements. A single species may provide easier hay management; however, it lacks diversity, leading to fewer soil health, pollinator and wildlife benefits.

An assessment of the hay stand prior to harvest is critical to determine the harvest date for maximum quality and yield. **Table 6** highlights specific properties and characteristics for each species listed. Please refer to **Table 1** for recommended seeding rates for single species and incorporating species into a mixture.

Table 6. Cover crop species and associated properties.

	Erosion Reduction	Increase Soil Organic Matter	Capture, Recycle, Redistribute Nutrients in the Soil Profile	Promote Biological Ntrogen Fixation	Weed Suppression	Provide Supplemental Hay	Provide Supplemental Grazing	Rooting Depth/Plant Water Use[1]	Minimize/Reduce Soil Compaction	Seed Size (Large or Fine)	Crop Type[2]	Seeding Depth, inches	Salinity Tolerance	C:N Ratio	Attract Beneficial Insects	Mycorrhizal Fungi Association
Cover Crop	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**13**	**14**	**15**	**16**	**17**
Barley	G	G	F	N	G	G	F	MM	F	L	CG	0.75 - 2.0	G	M	Y	L
Annual ryegrass	G	G	F	N	G	F	F	SM	F	F	CG	0.25 - 1.1	P	M	N/A	M
Berseemclover	P	P	F	Y	F	F	G	MH	F	F	CB	0.25 - 1.0	F	L	Y	L
Buckwheat	G	F	G	N	G	P	P	SL	P	F	WB	0.5 - 1.5	P	L	Y	N/A
Canola	F	F	G	N	P-G**	F	F	MM	G	F	CB	0.25 - 0.75	G	L	Y	N/A
Corn	G	G	G	N	P-G**	F	F	DH	G	L	WG	1.0 -1.5	P	H	N/A	H
Cowpeas	P	P	F	Y	G	F	F	SL	F	L	WB	1.0 - 1.5	P	L	Y	M
Crimson clover	G	F	F	G	F	F	F	MM	F	F	CB	0.25 - 0.75	NA	L	Y	H
Sunnhemp	F	F	G	G	G	NA	NA		G	F	WB	0.5 - 1.5	NA	L	N/A	M
Flax	F	F	F	N	P	P	P	SM	P	F	CB	0.25 - 0.75	P	H	N/A	H
Hairy vetch	G	F	F	Y	P	F	G	SM	F	L	CB	0.5 - 1.5	P	L	Y	M
Lentils	P	P	F	Y	P	F	F	SL	P	F	CB	1.0 -1.5	P	L	N/A	M
Medic	P	P	G	Y	F	F	F	MM	F	F	CB	0.25 - 0.75	P	L	N/A	M
Foxtail millet	G	G	F	N	G	G	F	SL	F	L	WG	0.25 - 0.75	F	M	N/A	H
Mustard, tame	F	F	F	N	G	F	F	MH	F	F	CB	0.25 - 0.75	P	L	Y	N/A
Oats	G	G	F	N	F	G	G	MM	F	L	CG	0.5 - 1.5	P	M	N	L
Peas	P	P	P	Y	F	G	F	SL	P	L	CB	1.5 - 3.0	P	L	Y	M
Phacelia	F	F	F	N	F	NA	NA	SL	P	F	CB	0.25 - 0.75	NA	L	Y	M
Radish	P	P	G	N	G	P	G	DH	G	F	CB	0.25 - 0.5	P	L	Y	N/A
Red beets	P	P	G	N	F	P	F	DM	G	L	CB	0.5 - 0.75	F	L	N	L
Red clover	F	F	F	Y	P	F	F	MM	F	F	CB	0.25 - 0.75	NA	L	Y	H
Safflowers	F	F	G	N	F	F	G	DH	F	L	WB	1.0 - 1.5	F	M	N	H
Sorghum	G	G	G	N	G	G	F	MM	G	L	WG	0.5 - 1.5	P	M	Y	H
Soybeans	P	P	F	Y	P-G**	F	F	SM	P	L	WB	1.0 - 1.5	P	L	N/A	M
Cereal rye or wheat	G	G	G	N	G	F	F	MH	F	L	CG	0.5 - 1.5	F-G	M	Y	L
Sudangrass, sudan-sorghum hybrid	G	G	G	N	G	G	G	MM	G	L	WG	0.5 - 1.5	F-G	M	Y	H
Sugarbeets	P	P	G	N	F	P	G	DH	G	F	CB	0.25 - 0.5	G	L	N/A	L
Sunflowers	F	F	G	N	F	P	G	DM	F	L	WB	0.5 - 1.0	F	M	N/A	H
Sweetclover	G	F	F	Y	F	F	F	MM	F	F	CB	0.25 - 1.0	F	L	Y	M
Triticale	G	G	G	N	G	G	F	MH	F	L	CG	0.5 - 1.5	G	M	Y	L
Turnipes	P	P	G	N	G	P	G	DH	G	F	CB	0.25 - 0.5	P-F	L	N/A	N/A
Winter cereal rye or wheat	G	G	G	N	G	F	G	MH	F	L	CG	0.75 - 2.0	P	M	Y	L

[1] **Rooting Depth/Water Use:** SL = shallow rooted/low water use; SM = shallow rooted/medium water use; SH = shallow rooted/high water use; ML = medium rooted/low water use; MM = medium rooted/medium water use; MH = medium rooted/high water use; DL = deep rooted/low water use; DM = deep rooted/medium water use; DH = deep rooted/high water use; Shallow = 6 to 18 inches; Medium = 18 to 24 inches; Deep = 24+ inches.

[2] **Crop types:** CG = cool-season grass; CB = cool-season broadleaf; WB = warm-season broadleaf; WG = warm-season grass.

Ratings: L = low; M = medium; H = high; N/A = not available; G = good; F = fair; P = poor.

** Poor weed competitor, but herbicide-tolerant varieties are available.

Table 5 was compiled from several sources listed in the USDA ARS 2012 "Cover Crop Design and Installation Guide" reference section and field observations.

Always consider seed cost, input resources and quality of purchased seed that has the potential to produce high-quantity and high-quality feed. If production costs exceed net profit return, a cover crop may not be an economically viable option. Soil health benefits are difficult to quantify and can provide an economic value.

Grazing cover crops does increase the fertility of the soil and aggregate stability of the soil particles, and may improve infiltration of water. The livestock producers also will save money in labor and fossil fuels, reducing the use of fossil fuels associated with hauling of manure and feeding cattle in a dry lot, and labor with feeding cattle in a dry lot.

Herd health benefits also may be found with cattle grazing longer on pasture versus being confined in a dry lot setting.

Summary

Cover crops potentially can enhance a livestock operation with an additional forage source and extended grazing season. A variety of species and mixes that can be adapted to fit producer needs are available.

The variability of annual rainfall events in North Dakota will determine the choice of a single-planting or a dual-use system. Planning for integrated cover crops should include a cost analysis of establishment and benefit for a system resource management strategy.

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