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Annual Cover Crop Options

for Grazing and Haying in the Northern Plains

The purpose of this publication is to provide annual forage options that can be used in cover crop mixtures for livestock grazing and/or hay production.

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The use of cover crops in a cropping rotation has been resurrected in recent years due to greater awareness of their environmental and ecological impacts on our natural resources.

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

Cover crops also may provide opportunities to use cropped land for grazing livestock or to produce baled feeds. Livestock grazing on cover crops can further recycle nutrients back into the soil. Baled cover crops as hay, when harvested at the correct time, can provide a nutrient-rich winter feed.

A whole-systems approach:

Resource concerns and objectives 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 loss and livestock drylot management.

Photo by Kevin Sedivec, NDSU Extension Service

Types of Forages Species

Many annual forage species can provide excellent grazing opportunities for livestock or hay mixtures. 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 considering haying options, seeding should occur in late spring to early summer for planned summer haying.

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).

Purpletop Turnip

Pasja Turnip

Photos by Kevin Sedivec

Cover Crop and Annual Forage Species

Cool-season

Cereal Grains	Broadleaf	Legumes
Oats (grain, forage)	Purpletop turnip (Brassica)	Field Pea
Barley (grain, forage)	Pasja turnip (Brassica)	Hairy vetch
Wheat (spring, winter)	Radish (Brassica)	Lentil
Triticale (spring, winter)	Kale (Brassica)	Berseem clover
Rye (spring, winter)	Sugar beet (Brassica)	Red clover
	Flax	Sweetclover
		Forage pea

Warm-season

Grasses	Broadleaf	Legumes
Foxtail millet	Sunflower	Soybean (grain or forage variety)
Proso millet	Buckwheat	Chickpea
Pearl millet	Amaranth	Mung bean
Sudangrass		Cow pea
Sorghum		
Sorghum-sudan cross		
Corn		

Example of cover crop mixture using brassicas, small grains and legumes

(Photo by Tim Becker, NDSU Extension Service)

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.

In other areas of the country, fall cover crop seed is being applied aerially onto growing corn as it is drying down and enough sunlight can penetrate the ground between the corn rows. In North Dakota, this has been done with corn in the tassel stage due to wider row spacing that allows more natural sunlight.

Recommended seeding rates, depths and dates for each cover crop also must be considered when planning to integrate cover crops into an operation **(Tables 2, 5 and 6)**. Cover crops for late-season grazing should be seeded no later than Aug. 15 to be cost-effective, and in many years, it should be seeded by the first of August so that the 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.

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

Cover Crops for Spring Grazing (late April to early June)

Spring grazing options require preplanning eight to 12 months prior to forage utilization. The most common options are winter cereal crops planted in early to mid-September. Winter cereal options include winter wheat, winter rye and winter triticale. The use of a winter annual such as hairy vetch may be incorporated into a cereal crop seed mixture to enhance soil health benefits and diversity in the forage system while providing an additional source of protein and energy for grazing livestock.

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, winter triticale provides the most palatable feed type while winter rye is least desired. In recent years, winter triticale seed has been the least cost effective, while winter rye has been the most cost effective **(Table 1)**. Thoughtful planning of early spring grazing or later season haying must be considered when choosing a cereal grain type or mix.

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

Spring grazing of cereal varieties should occur at the optimum stage of plant development for animal nutritional requirements. The cereal grains below **(Table 1)** 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.

Table 1. Winter cereal grain trait comparisons.

Winter Cereal Type[1]	Palatability	Nutritional Content[2] CP	TDN	Forage Production	Allopathic Effect on Other Crops[3]	Weed Control	Hardiness and Disease Resistant	Cost
		%	%					
Winter wheat[3]	0	13.5	58.2	0	0	0	0	0
Winter rye[4]	–	12.4	55.9	+	–	+	+	+
Winter triticale	+	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 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 2. Seeding rate, depth and date for winter cereals in North Dakota.

Winter Cereal Type	Seeding Rate	Seeding Depth	Seeding Date
	(pounds/acre)	(inches)	
Winter wheat	60-70	1.0-1.5	Sept. 10-20
Winter rye	56-75	1.0-1.5	Sept. 10-25
Winter triticale	96-120	1.0	Sept. 10-20

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 3)**. In some operations, dual use of a cover crop is preferred, with haying followed by grazing if sufficient regrowth provides full use of the resource.

Table 3. Annual cover crop options for grazing or haying.

Forage Type	Grazing	Hay	Hay Followed by Grazing	Haylage/Baleage/ Silage Followed by Grazing
Spring cereal crops	X	X	X	X
Foxtail millet	X	X	X	
Brassicas	X			X
Sudangrass	X	X	X	
Sorghum	X	X		X
Sorghum-sudangrass	X	X		X
Pearl millet	X	X	X	X
Proso millet	X	X	X	X
Sunflower	X			
Buckwheat	X			
Forage/field pea	X	X	X	X
Cow pea	X	X	X	
Chickpea	X	X	X	
Hairy vetch	X	X	X	
Lentils	X	X	X	
Soybeans	X	X		X
Berseen clover	X	X	X	
Sweetclover	X	X	X	X
Flax	X			

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

(Photo by Rick Bohn, Central Grasslands Research Extension Center)

Cover Crops for Late-season Grazing (mid-September to mid-January)

Cover crops for late-season grazing can provide a significant cost savings to producers by minimizing the need for baled forages. Brassica or turnip varieties will dominate this season due to their remarkable forage quality, even after a killing frost **(Table 4)**. 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)

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 midsummer 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.

Table 4. Cover crop forage quality (seeded in late July/early August) for late-season grazing.

Late-season crop	Nutritional Content Pre-freeze				Nutritional Content Post-freeze[1]			
	CP[2]	IVDMD[3]	Ca[4]	P[5]	CP %	IVDMD	Ca	P
Cowpea[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
Soybean[7]	14.2	75.1	1.48	0.37	11.0	59.2	1.24	0.28
Sunflower[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
Oat[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. IVDMD can be utilized for energy measurements in the livestock diet.

[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)

Cover crops for late-season grazing should be seeded no later than Aug. 15 to be cost effective. 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 crop is removed.

If 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 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 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 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.

The following example mixtures **(Table 5)** have associated seeding rates. This mix or a similar combination potentially could provide low-cost grazeable forage in North Dakota.

Table 5. Example cover crop mixtures tested in North Dakota for eastern and western North Dakota.

Seed the entire mixture as one crop, creating a six-species cover crop mixture.

Grazing Forage Option	Eastern North Dakota	Western North Dakota
	(pounds/acre)	(pounds/acre)
Oats (forage)	15	15
German millet	4	
Siberian millet		4
Sunflower	1-1.5	1
Radish	1	1-2
Turnip (pajsa)	0.5	0.75
Field pea		10
Forage pea	10	

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, brassicas, and pearl and proso 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 below 18 inches immediately after a light frost. After a hard frost, wait for 10 days to two weeks before turning livestock out onto new growth and six days before turning them out on mature growth, or until the entire plant has been killed by a freeze. Check with your local Extension agent for more information.

Sweetclover poisoning

Sweetclover harvested improperly for hay, haylage, baleage and silage may contain dicoumarin when it becomes moldy. A substance referred to as coumarin is present in varying amounts in all sweetclover. In sweetclover that is spoiled or damaged, the coumarin is converted to a toxic substance called dicoumarin. This toxic compound prevents normal blood clotting resulting in hemorrhages and associated symptoms.

Oilseed inclusion

Flax should be limited to 12 percent of a livestock diet (dry matter) because of its high fat content. Excessive fat (more than 5 percent 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 adding nutrient distribution through livestock manure.

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.

An assessment of the hay stand prior to harvest is critical to determine the harvest date for maximum quality and yield. Seeding rates given below are for a single-species hay crop **(Table 6)**. Table 6 also provides specific properties and characteristics for each species listed.

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]	Full Seeding Rate, lbs/acre	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**	**12**	**13**	**14**	**15**	**16**	**17**
Barley	G	G	F	N	G	G	F	MM	F	L	CG	100	0.75-2.0	G	M	Y	L
Annual ryegrass	G	G	F	N	G	F	F	SM	F	F	CG	10	0.25-1.1	P	M	N/A	M
Berseemclover	P	P	F	Y	F	F	G	MH	F	F	CB	8	0.25-1.0	F	L	Y	L
Buckwheat	G	F	G	N	G	P	P	SL	P	F	WB	48	0.5-1.5	P	L	Y	N/A
Canola	F	F	G	N	P-G**	F	F	MM	G	F	CB	5	0.25-0.75	G	L	Y	N/A
Corn	G	G	G	N	P-G**	F	F	DH	G	L	WG	20	1.0 -1.5	P	H	N/A	H
Cowpea	P	P	F	Y	G	F	F	SL	F	L	WB	30	1.0-1.5	P	L	Y	M
Crimson clover	G	F	F	G	F	F	F	MM	F	F	CB	15	0.25-0.75	NA	L	Y	H
Sunn hemp	F	F	G	G	G	NA	NA		G	F	WB	5	0.5-1.5	NA	L	N/A	M
Flax	F	F	F	N	P	P	P	SM	P	F	CB	50	0.25-0.75	P	H	N/A	H
Hairy vetch	G	F	F	Y	P	F	G	SM	F	L	CB	15	0.5-1.5	P	L	Y	M
Lentil	P	P	F	Y	P	F	F	SL	P	F	CB	80	1.0 -1.5	P	L	N/A	M
Medic	P	P	G	Y	F	F	F	MM	F	F	CB	8	0.25-0.75	P	L	N/A	M
Millet	G	G	F	N	G	G	F	SL	F	L	WG	15-25	0.25-0.75	F	M	N/A	H
Mustard, tame	F	F	F	N	G	F	F	MH	F	F	CB	5	0.25-0.75	P	L	Y	N/A
Oats	G	G	F	N	F	G	G	MM	F	L	CG	60	0.5-1.5	P	M	N	L
Peas	P	P	P	Y	F	G	F	SL	P	L	CB	50	1.5-3.0	P	L	Y	M
Phacelia	F	F	F	N	F	NA	NA	SL	P	F	CB	5	0.25-0.75	NA	L	Y	M
Radishes	P	P	G	N	G	P	G	DH	G	F	CB	5	0.25-0.5	P	L	Y	N/A
Red beets	P	P	G	N	F	P	F	DM	G	L	CB	8	0.5-0.75	F	L	N	L
Red clover	F	F	F	Y	P	F	F	MM	F	F	CB	6	0.25-0.75	NA	L	Y	H
Safflower	F	F	G	N	F	F	G	DH	F	L	WB	30	1.0-1.5	F	M	N	H
Sorghum	G	G	G	N	G	G	F	MM	G	L	WG	25-35	0.5-1.5	P	M	Y	H
Soybeans	P	P	F	Y	P-G**	F	F	SM	P	L	WB	45	1.0-1.5	P	L	N/A	M
Spring rye or wheat	G	G	G	N	G	F	F	MH	F	L	CG	60	0.5-1.5	F-G	M	Y L	
Sudangrass, sudan-sorghum hybrid	G	G	G	N	G	G	G	MM	G	L	WG	25-35	0.5-1.5	F-G	M	Y	H
Sugar beets	P	P	G	N	F	P	G	DH	G	F	CB	8	0.25-0.5	G	L	N/A	L
Sunflowers	F	F	G	N	F	P	G	DM	F	L	WB	4	0.5-1.0	F	M	N/A	H
Sweetclover	G	F	F	Y	F	F	F	MM	F	F	CB	6	0.25-1.0	F	L	Y	M
Triticale	G	G	G	N	G	G	F	MH	F	L	CG	60-100	0.5-1.5	G	M	Y	L
Turnipes	P	P	G	N	G	P	G	DH	G	F	CB	4	0.25-0.5	P-F	L	N/A	N/A
Winter rye or wheat	G	G	G	N	G	F	G	MH	F	L	CG	60-100	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.

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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Always consider seed cost, input resources and quality of purchased seed that has the potential to produce high-quantity and 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 drylot, and labor with feeding cattle in a drylot.

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

Cover photo by Rick Bohn, Central Grasslands Research Extension Center

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