

# Cool-Season Annual Forages for Hay in North Dakota

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Annual cool-season forages are a great alternative for high quality supplemental forage needs. Oat and barley are the most commonly grown annual forages for hay in North Dakota. Oat and barley hay acreage was 115,874 and 54,900 acres, respectively in 2010. Oat/pea forage acreage was reported at 17,491 in 2010.

In a study conducted in North Dakota, oat hay resulted in higher forage yield with barley hay being higher in forage quality in western North Dakota. Triticale, although somewhat new to North Dakota, is a cereal of choice in the Northeast, because it is high yielding (2.5-4 ton/ac), it is good quality forage early in the summer season, and it allows a double crop such as sorghum, sudangrass, or short season corn.

Mixing legumes with cereal crops improves forage quality and yield, reduces nitrogen (N) inputs, and improves soil health. A North Dakota study reported an increase in crude protein (CP) from 4% to 5.9% in oat or barley hay when intercropped with forage peas.

The study objective was to identify annual forages, planted alone or in combinations, with high forage yield and quality in North Dakota.

## Materials and Methods

Several varieties of forage barley, oat, triticale, and mixtures with pea, hairy vetch, black lentil, radish, and turnip were evaluated at three locations: Fargo, Prosper, and Carrington in 2010. All legumes were inoculated with the proper strain of bacteria for N fixation to occur. The experimental design in all locations was a randomized complete block design with three replicates. Biomass yield was determined using dry weight for each experimental unit and wet chemistry analysis was conducted to determine forage quality. The components evaluated included CP (Kjeldahl method), ADF, NDF, ADL, NDFD (at 48 hours according to the Van Soest method), and in vitro DM digestibility. Total digestible nutrients (TDN) and relative forage quality (RFQ) were calculated using the standard formulas.

## Results

Dry matter yield fluctuated between 2.5-4.2, 2.7-4.5, and 1.1-2.5 tons DM/ac at Fargo, Prosper, and Carrington, respectively (Table 1).

The highest DM yield at Fargo was for triticale (Trical 141) or triticale (Merlin)/pea(Arvika) mixture. The highest yielding forage at Prosper was the mixture of oat (Everleaf)/pea (Arvika). Cool-season annuals were harvested in July at various stages for each of the cereal crops, which would allow a second crop for biomass production in the same season. General harvest stage for the cereals

Table 1. Cool-season annual forage yield at 3 locations in North Dakota in 2010.

Crop	Variety	Fargo	Prosper	Carrington	Fargo	Prosper	Carrington
		Harvest Date			Forage Yield (tons/ac)		
Forage Barley	Hayes	July 6	July 7	July 8	3.5	2.7	2.1
Forage Barley	Haybet	July 6	July 7	July 8	3.3	3.0	2.2
Forage Barley	Stockford	July 6	July 7	July 8	3.3	2.9	2.0
Forage Barley	Lavina	July 6	July 7	July 8	3.3	2.9	2.0
Forage Triticale	Merlin	July 9	July 7	July 2	2.9	3.1	1.1
Forage Triticale	Trical 141	July 9	July 7	July 8	4.2	3.4	1.8
Forage Oat	Everleaf	July 12	July 7	July 15	3.8	3.8	1.1
Forage Oat	Kona	July 6	July 7	July 15	3.1	2.8	1.4
Grain Oat	HiFi	July 6	July 7	July 15	3.1	3.0	2.1
Grain Oat	Morton	July 6	July 7	July 15	2.9	2.7	2.2
Naked Oat	Paul	July 15	July 13	July 15	3.0	3.5	1.4
Forage Pea	Arvika	July 6	July 7	July 8	2.5	3.0	2.1
Oat/Pea	Morton/Arvika	July 6	July 7	July 15	2.8	3.0	2.0
Barley/Pea	Haybet/Arvika	July 6	July 7	July 8	3.6	2.8	2.5
Oat/Pea	Everleaf/Arvika	July 12	July 13	July 15	3.5	4.5	1.1
Triticale/Pea	Merlin/Arvika	July 6	July 9	July 2	4.1	3.7	1.3
Oat/Turnip	Morton/Purple Top	July 6	July 7	-	3.0	2.8	-
Oat/Hairy Vetch	Morton/Purple Bounty	July 6	July 7	-	3.3	2.9	-
Oat/Winter Pea/Hairy Vetch	Morton/Austrian/Purple Bounty	July 6	July 7	-	3.1	3.0	-
Oat/Black Lentil	Morton/Indian Head	July 6	July 7	July 15	3.3	2.9	1.2
CV (%)					12.1	16.9	22.6
LSD (0.05)					0.6	0.8	0.5

Seeding dates: 4/21/2010 at Prosper and Fargo and 4/29/2010 at Carrington.

were: forage barley at early-dough, oats at early-milk, and triticale at anthesis or flowering. Forage yields at Carrington were lower for all forages and mixtures, which is expected since it is a drier location. The highest forage yields were obtained with forage barley, Haybet, combined with forage pea (Arvika) at Carrington in 2010 (Table 1).

At Prosper, the early harvest of forage cereals in mixtures allowed the regrowth of peas, hairy vetch, and radishes once the cereal was removed, providing an additional 0.5-1 ton/ac of forage for grazing or cover crop use for the remainder of the season.

Forage quality overall was good for all forages evaluated. Crude protein was greater than 10%, RFQ greater than 118, and digestibility values for IVDMD and NDFD were also high. Forage quality was increased by including pea in the mixture with Haybet barley. Crude protein increased from 12.0 to 16.7% and RFQ increased from 147 to 159 (Table 2) when peas were grown with barley. Quality also increased for Everleaf and Morton oats and triticale when peas were added to the mixture.

Results indicate that cool-season annual forages can be used as supplemental forage with excellent forage quality. Producing annual forages on cropland also provides flexibility in the crop rotation. Annual cool-season harvest occurs the first or second week of July, allowing enough time to plant and grow a warm-season annual forage or crop intended for grazing in the fall.

**Table 2.** Cool-season annual forage quality across locations in North Dakota in 2010.

Crop	Variety	CP	NDF	ADF	ADL	IVDMD	TDN	NDFD	RFQ
		% DM						% NDF	
Forage Barley	Hayes	12.1	53.1	29.8	4.0	68.1	61.7	73.9	143
Forage Barley	Haybet	12.0	53.1	29.9	3.8	66.5	62.6	74.0	147
Forage Barley	Stockford	11.9	52.4	30.1	3.9	69.3	62.8	74.7	147
Forage Barley	Lavina	11.3	53.0	30.1	4.2	67.3	62.8	71.7	146
Forage Triticale	Merlin	11.3	56.0	32.4	5.9	55.2	57.3	61.0	121
Forage Triticale	Trical 141	12.1	58.3	34.8	5.9	54.8	56.5	61.3	118
Forage Oat	Everleaf	12.2	62.2	38.0	5.4	59.8	54.5	64.2	104
Forage Oat	Kona	12.4	58.2	35.1	4.9	58.5	57.7	63.3	121
Grain Oat	HiFi	10.5	58.8	36.2	5.5	54.9	57.5	59.5	118
Grain Oat	Morton	11.0	57.2	34.9	5.7	54.5	57.7	59.6	120
Naked Oat	Paul	11.1	50.3	29.9	5.0	57.4	61.0	62.5	137
Forage Pea	Arvika	20.4	36.6	28.4	5.8	68.3	66.4	72.8	151
Oat/Pea	Morton/Arvika	12.7	56.1	34.5	5.4	57.6	58.4	60.9	126
Barley/Pea	Haybet/Arvika	16.7	44.3	28.3	4.6	70.2	65.4	74.6	159
Oat/Pea	Everleaf/Arvika	14.2	56.5	34.2	5.0	62.6	57.9	67.3	124
Triticale/Pea	Merlin/Arvika	13.5	52.1	31.0	6.0	58.7	59.6	64.7	134
Oat/Turnip	Morton/ Purple Top	10.8	58.1	35.6	5.7	54.1	57.3	58.9	119
Oat/Hairy Vetch	Morton/ Purple Bounty	11.8	58.2	35.6	5.8	54.4	57.2	58.9	119
Oat/Winter Pea/ Hairy Vetch	Morton/Austrian/ Purple Bounty	12.2	56.8	35.1	5.4	55.3	58.1	60.0	124
Oat/Black Lentil	Morton/ Indian Head	11.3	58.5	35.8	5.8	56.9	57.2	59.0	118
CV (%)		8.7	4.1	5.2	7.9	4.3	2.4	2.2	7.8
LSD (0.05)		3.2	6.1	3.0	0.7	3.4	2.6	3.0	14

CP= crude protein, NDF= neutral detergent fiber; ADF= acid detergent fiber; ADL= acid detergent lignin; IVDMD= in vitro dry matter digestibility; TDN= total digestible nutrients; NDFD= neutral detergent fiber digestibility; RFQ= relative forage quality.