

# Cool-Season Annual Forages for Hay in North Dakota

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## Introduction

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. 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 by Carr et al. (2001), 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 North East, because is high yielding (2.7 to 4.5 ton/acre), good quality forage early in the summer season, and allows a double crop such as sorghum, sudangrass, or short season corn (Kilcer, 2010).

Mixing legumes with cereal crops improves forage quality and yield, reduces nitrogen inputs, and improves soil health. Carr et al. (2001) reported an increase in crude protein from 4% to 5.9% in oat or barley hay when intercropped with forage peas.

The objective of this study was to identify annual forages, planted sole 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, Carrington, ND in 2010. All legumes were inoculated with the proper strain of bacteria for nitrogen 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 crude protein (CP) (Kjeldahl method), acid detergent fiber (ADF), neutral detergent fiber (NDF), acid detergent lignin (ADL), and neutral detergent fiber digestibility (NDFD), 48 hours, according to the Van Soest method (Van Soest, 1994), and *in vitro* dry matter digestibility (Tilley and Terry, 1963). Total digestible nutrients (TDN) and relative forage quality (RFQ) were calculated using the standard formulas (Undersander and Moore, 2002).

## Results

Dry matter yield fluctuated between 2.9 and 4.2, 2.7 and 4.5, and 1.1 to 2.5 lbs dry matter/acre at Fargo, Prosper, and Carrington, respectively ([Table 1](#)).

Highest dry matter 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; this would allow a second crop for biomass production in the same season. General harvest stage for the cereals were: forage barley at early-dough, oats at early-milk, and triticale at anthesis or flowering. Forage yield at Carrington were lower for all forages and mixtures, which is expected since Carrington is a drier location. 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 to 1 ton/acre 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.

These 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 1. Cool-season annual forage yield at three locations in North Dakota in 2010.

Crop	Variety	Fargo	Prosper	Carrington	Fargo	Prosper	Carrington
		Harvest date			Forage yield		
					tons/acre		
forage barley	Hayes	6-Jul	7-Jul	8-Jul	3.5	2.7	2.1
forage barley	Haybet	6-Jul	7-Jul	8-Jul	3.3	3.0	2.2
forage barley	Stockford	6-Jul	7-Jul	8-Jul	3.3	2.9	2.0
forage barley	Lavina	6-Jul	7-Jul	8-Jul	3.3	2.9	2.0
forage triticale	Merlin	9-Jul	7-Jul	2-Jul	2.9	3.1	1.1
forage triticale	Trical 141	9-Jul	7-Jul	8-Jul	4.2	3.4	1.8
forage oat	Everleaf	12-Jul	7-Jul	15-Jul	3.8	3.8	1.1
forage oat	Kona	6-Jul	7-Jul	15-Jul	3.1	2.8	1.4
grain oat	HiFi	6-Jul	7-Jul	15-Jul	3.1	3.0	2.1
grain oat	Morton	6-Jul	7-Jul	15-Jul	2.9	2.7	2.2
naked oat	Paul	15-Jul	13-Jul	15-Jul	3.0	3.5	1.4
forage pea	Arvika	6-Jul	7-Jul	8-Jul	2.5	3.0	2.1
oat/pea	Morton/Arvika	6-Jul	7-Jul	15-Jul	2.8	3.0	2.0
barley/pea	Haybet/Arvika	6-Jul	7-Jul	8-Jul	3.6	2.8	2.5
oat/pea	Everleaf/Arvika	12-Jul	13-Jul	15-Jul	3.5	4.5	1.1
triticale/pea	Merlin/Arvika	6-Jul	9-Jul	2-Jul	4.1	3.7	1.3
oat/ turnip	Morton/ Purple top	6-Jul	7-Jul	-	3.0	2.8	-
oat/hairy vetch	Morton/Purple bounty	6-Jul	7-Jul	-	3.3	2.9	-
oat/winter peas/hairy vetch	Morton/Austrian /Purple Bounty	6-Jul	7-Jul	-	3.1	3.0	-
oat/black lentil	Morton/ Indian head	6-Jul	7-Jul	15-Jul	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.

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

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

†CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = Acid detergent lignin; NDFD = neutral detergent fiber digestibility; IVDMD = in vitro dry matter digestibility; NDFD = Neutral detergent fiber digestibility; RFQ = relative forage quality

## References

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