2010

Spring Cereal Grain Forage Trials

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UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

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Barley and forage brassica in a mixed seeding

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In 2010, the University of Vermont Extension continued their research evaluating several organic annual forage models. Spring cereal grains such as oats, barley, triticale, wheat, and spelt could have the potential to provide high yield and quality feed for livestock. Spring grains are planted in mid to late April and can be harvested at various stages of development. The objective of this project was to evaluate yield and quality of spring grains harvested in the boot, milk, or soft dough stage. The overall goal of this project is to help organic dairy producers reduce their reliance on expensive concentrates through the production of a variety of high quality annul forages. In addition, we were interested in investigating the value of combining brassica forage with these cool season annuals.

TESTING PROCEDURE

The replicated research plots were located at Borderview Farm in Alburgh, VT. The experimental design was a randomized complete block with four replicates. All plots were managed with conventional tillage practices. Conventional tillage includes moldboard plow, disking, and field finishing with a drag harrow. Pro-Gro was applied at a rate of 50 lbs/acre at tillering in the spring cereal grain trials. The application rate was based on soil test analysis and UVM nutrient recommendations for field crops. Manure was fall-applied to meet help meet nitrogen needs while trying to minimize over application of phosphorus. The plots were 5' x 25'. The plots were seeded on April 22, 2010 with a John Deere grain drill. The oats, barley, spelt, and triticale were planted at 125 lbs/acre. The Barkant turnips were planted at 8 lbs/acre, and Oats Plus was planted at 100 lbs/acre. The varieties and seed source are in Table 1.

Table 1. Spring cereal grain and turnip variety and source.

Company	Type	Variety
D&S Hansen Farms, Inc	Forage Oats	Everleaf 126
Minnesota Certified Seed	Grain Oats	Spur
King's Agriseeds, Inc	60% Jerry Oats 38% Marshall Annual Ryegrass	Oats Plus
Lakeview Organic Grain	Spelt	Not stated
Lakeview Organic Grain	Barley	Not stated
Welter Seed & Honey	Triticale	Not stated
Barenbrug	Forage turnip (*Brassica rapa*)	Barkant Turnip

Each treatment was harvested at three development stages, boot stage, milk stage, and soft dough stage. The first harvest took place on June 15th, 2010 when the Spur oats, spelt, barley, and triticale were in the boot stage, while the Everleaf oats and the Oats Plus mix were in the vegetative stage. The second harvest took place on July 6th, 2010 when the treatments were in between just heading out and the milk stage. The third harvest took place on July 20th, 2010. The majority of the barley treatments had been decimated by birds. The spelt, oats, and triticale were in the early to soft dough stage. The Everleaf oats and Oats Plus mix were in early dough. Once the plots were harvested, all plant material was collected and weighed on a platform scale. A subsample of approximately 1 lb was taken to determine moisture and quality. The LSD procedure was used to separate cultivar means when the F-test was significant (P <

0.10). Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among hybrids is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSD) at the 10% level of probability are shown in the results. Where the difference between two treatments within a column is equal to or greater than the LSD value you can be sure 9 times out of 10 that there is a real difference between the two treatments.

Table 2. Planting date and harvest dates of the spring cereal and brassica trial.

	Borderview Farm, Alburgh, VT
Seeding rate – Oats	125 lbs/acre
Seeding rate – Oats Plus	96 lbs/acre
Seeding rate – spelt	125 lbs/acre
Seeding rate – barley	125 lbs/acre
Seeding rate – triticale	125 lbs/acre
Seeding rate – brassica	8 lbs/acre
Planting date	22-Apr-2010
Harvest 1	15-June-2010
Harvest 2	6-July-2010
Harvest 3	20-July-2010

WEATHER DATA

Seasonal precipitation and temperatures recorded at a weather station in close proximity to the 2010 research sites are shown in Table 3. This year spring temperatures were higher than usual, and while we had a drier spring, overall, we ended up with above average rainfall. In Alburgh, the growing season resulted in 575 more small-grain Growing Degree Days (GDD) than the thirty year average.

Table 3. Temperature, precipitation, and Growing Degree Day summary, Alburgh, VT.

	April	May	June	July	August	September	October
Average Temperature (°F)	49.3	59.6	66.0	74.1	70.4	64.0	50.6
Departure from Normal	5.80	3.00	0.20	3.00	1.40	3.60	1.80
Precipitation (inches)	2.76	0.92	4.61	4.30	5.48	4.32	missing
Departure from Normal	0.25	-2.01	1.40	0.89	1.63	0.86	data
Growing Degree Days (base 50°)	141	332	479	747	634	419	129
Departure from Normal	101	71.4	4.50	94.6	45.0	107	26.4
Growing Degree Days (base 32°)	521	854	1019	1305	1192	959	578
Departure from Normal	176	91.5	4.5	94.6	45.0	107	57.4

Based on National Weather Service data from cooperative observer stations in close proximity to field trials. Historical averages are for 30 years of data (1971-2000).

SILAGE QUALITY

Silage quality was analyzed by Cumberland Valley Analytical Forage Laboratory in Hagerstown, Maryland. Plot samples were dried, ground and analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and various other nutrients. The Nonstructural Carbohydrates (NSC) and Total Digestible Nutrients (TDN) were calculated from forage analysis data. Performance indices such as Net Energy Lactation (NEL) were calculated to determine forage value. Mixtures of true proteins, composed of amino acids, and nonprotein nitrogen make up the crude protein (CP) content of forages. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of the plant are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, non-protein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF). Chemically, this fraction includes cellulose, hemicellulose, and lignin. The NSC or non-fiber carbohydrates (NFC) include starch, sugars, and pectins.

RESULTS

Spring Cereals

When evaluating the main effect of cereal grain species (averaged across all harvest times) the oats had significantly higher yields than the other grains (Table 4). Overall barley had the lowest fiber concentrations and ranked as one of the highest quality grains. The forage oat variety 'Everleaf' and the triticale also had higher protein and NeL levels than the other grains (Table 4).

Table4. Dry matter yield and quality of annual spring forages compared across harvest stages.

Annual spring forage	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Barley	22.3	3930	13.8*	**32.1***	**47.5***	54.4	**61.6***	0.62*
Everleaf oats	19.9	5220*	13.6*	35.1	55.4	**58.2***	60.4	0.62*
Oats Plus mix	**26.9***	4510	12.0	36.8	56.8	50.6	58.9	0.60
Spelt	21.0	3580	13.2	34.6	50.1	54.4	59.3	0.61
Spur oats	25.5*	**5370***	12.1	37.1	57.7	51.0	59.0	0.61
Triticale	21.7	4450	**14.2***	33.6	50.0	55.7	60.7	**0.62***
LSD (0.10)	1.86	465	0.767	1.08	2.22	2.40	0.82	0.01
Means	22.9	4510	13.1	34.9	52.9	54.0	60.0	0.61

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.

When evaluating the effect of harvest time, cereals harvested in the boot stage had the lowest yield but highest quality (Table 5). The soft dough and milk stage harvests performed similarly in both yield and quality. Harvesting in the milk or soft dough stage can double dry matter yield per acre as compared to boot stage harvested grains. This trend is similar to what is observed in perennial cool season grasses where protein and quality declines as the plant matures.

Table 5. Dry matter yield and quality of annual spring forages at different harvest stages.

Harvest stage	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Boot	14.8	2030	**19.2***	**29.0***	**44.4***	**64.1***	**63.4***	**0.66***
Milk	**27.5***	5680*	10.2	38.3	59.5	51.1	58.6	0.59
Soft dough	26.3*	**5830***	10.0	37.4	54.9	47.0	57.9	0.59
LSD (0.10)	1.32	329	0.54	0.77	1.57	1.70	0.58	0.01
Means	22.9	4510	13.1	34.9	52.9	54.0	60.0	0.61

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.

Each harvest time was analyzed separately to determine if the grain species differed in yield and quality by harvest time. There was no significant difference in yield among the grains when harvested in the boot stage (Table 6). On average the boot stage harvested grains yielded about one ton per acre of dry matter. The cereals did not differ in CP. The fiber concentrations (ADF and NDF) were highest in the grain oat variety "Spur". This makes sense considering grain varieties would be selected for standability and most likely have higher lignin levels than a forage oat. Interestingly, oat varieties, barley, and triticale had statistically similar digestible fiber content.

Table 6. Dry matter yield and quality of annual spring forages harvested at the boot stage.

Small grain **boot** harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Barley	14.7	1840	19.6	28.0*	42.6*	64.1*	63.7*	0.65
Everleaf oats	14.9	2010	19.1	28.0*	43.9*	**67.6***	**64.9***	**0.68***
Oats Plus mix	**15.8**	1760	18.4	30.6	48.9	66.4*	63.3	0.65
Spelt	14.2	1820	**19.9**	**27.7***	**38.9***	57.6	62.1	0.64
Spur oats	15.0	**2370**	18.6	30.5	48.4	66.3*	64.0*	0.66*
Triticale	14.2	2360	19.7	29.2*	43.7*	62.3*	62.7	0.65
LSD (0.10)	NS	NS	NS	1.92	5.75	5.67	1.47	0.02
Mean	14.8	2030	19.2	29.0	44.4	64.1	63.4	0.66

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

Small grains harvested at the milk stage produced between 4450 and 7370 lbs of dry matter per acre, with the Spur oats and triticale being the highest yielding (Table 7). Crude protein was not significant between the treatments. Barley had the lowest ADF and highest TDN. Barley also had the lowest NDF, although it was not statistically different than the Oats Plus mix, spelt, or triticale. Everleaf oats had the highest dNDF.

Table 7. Dry matter yield and quality of annual spring forages harvested at the milk stage.

Small grain **milk** harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Barley	**31.0***	4710	10.2	**35.2***	**57.0***	45.4	**60.8***	0.58
Everleaf oats	19.2	5790	**11.1**	39.6	62.3	**60.4***	57.5	0.59
Oats Plus mix	30.9*	5350	10.4	38.1	59.4*	47.3	58.4	**0.60**
Spelt	26.8*	4450	9.20	39.0	59.7*	54.4	58.4	0.60
Spur oats	28.7*	**7270***	9.80	39.5	61.4	46.8	57.7	0.59
Triticale	28.3*	6470*	10.7	38.3	57.1*	52.0	58.8	**0.60**
LSD (0.10)	4.43	1020	NS	2.18	3.08	4.87	1.84	NS
Mean	27.5	5680	10.2	38.3	59.5	51.1	58.6	0.59

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

Small grains harvested at the soft dough stage yielded between 4470 and 7850 lbs of dry matter per acre just slightly higher than the milk stage harvested grains. Everleaf oats were the highest yielding of all the treatments (Table 8). Triticale and barley maintained the highest protein concentrations. Barley and triticale had the lowest fiber concentrations, highest fiber digestibility, and highest NeL.

Table 8. Dry matter yield and quality of annual spring forages harvested at the soft dough stage.

Small grain **soft dough** harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Barley	21.3	5250	11.5*	**33.0***	**43.0***	**53.6***	60.3*	**0.62***
Everleaf oats	25.6	**7850***	10.5	37.8	60.0	46.5	58.8	0.60
Oats Plus mix	**34.0***	6400	7.20	41.8	62.2	38.1	55.1	0.56
Spelt	21.9	4470	10.7	37.0	51.6	51.2	57.5	0.58
Spur oats	32.7*	6460	8.00	41.4	63.3	39.8	55.4	0.57
Triticale	22.5	4530	**12.1***	33.2*	49.2	52.9*	**60.5***	0.62*
LSD (0.10)	2.95	971	0.65	1.54	2.08	2.23	1.11	0.01
Mean	26.3	5830	10.0	37.4	54.9	47.0	57.9	0.59

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.

Spring Cereals Combined with Forage Turnips

Brassica forage crops have been reported to have near concentrate quality. This forage crop also prefers to grow under cool weather conditions. This project was interested in evaluating the impact that brassica would have on overall forage yield and quality when mixed with spring cereal grains. Barkant forage turnips were mixed with triticale, spelt, or 'Everleaf' forage oats.

When evaluating the main effect of cereal grains (across all harvest dates) dry matter yields ranged from 3,300 – 5,220 lbs of dry matter/acre (Table 8; Figure 1). The 'Everleaf' oats yielded over 2.5 tons of dry matter per acre with or without turnips. Spelt was the lowest yielding forage crop with and without turnips. When spelt was interseeded with turnips, it decreased fiber concentrations as compared to the other treatments.

Table 8. Yield and quality of annual spring forages interseeded with turnips across all harvest stages.

Treatment	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Everleaf oats	19.9*	**5220***	13.6	35.1	55.4	**58.2***	60.4*	0.62*
Everleaf oats + Barkant turnips	17.8	5030*	**14.4***	34.4	52.3	58.0*	60.1*	0.62*
Spelt	21.0*	3580	13.2	34.6	50.1	54.4	59.3	0.61
Spelt + Barkant turnips	19.9*	3300	13.8*	**32.6***	**45.2***	54.8	60.4*	0.62*
Triticale	21.2*	4540	14.3*	33.6	50.2	55.7*	**60.6***	**0.62***
Triticale + Barkant turnips	**22.0***	4140	13.7*	34.2	50.0	54.6	60.4*	0.62*
LSD (0.10)	2.21	459	0.76	0.87	2.00	2.84	0.70	0.01
Means	20.3	4300	13.8	34.1	50.5	55.9	60.2	0.62

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.

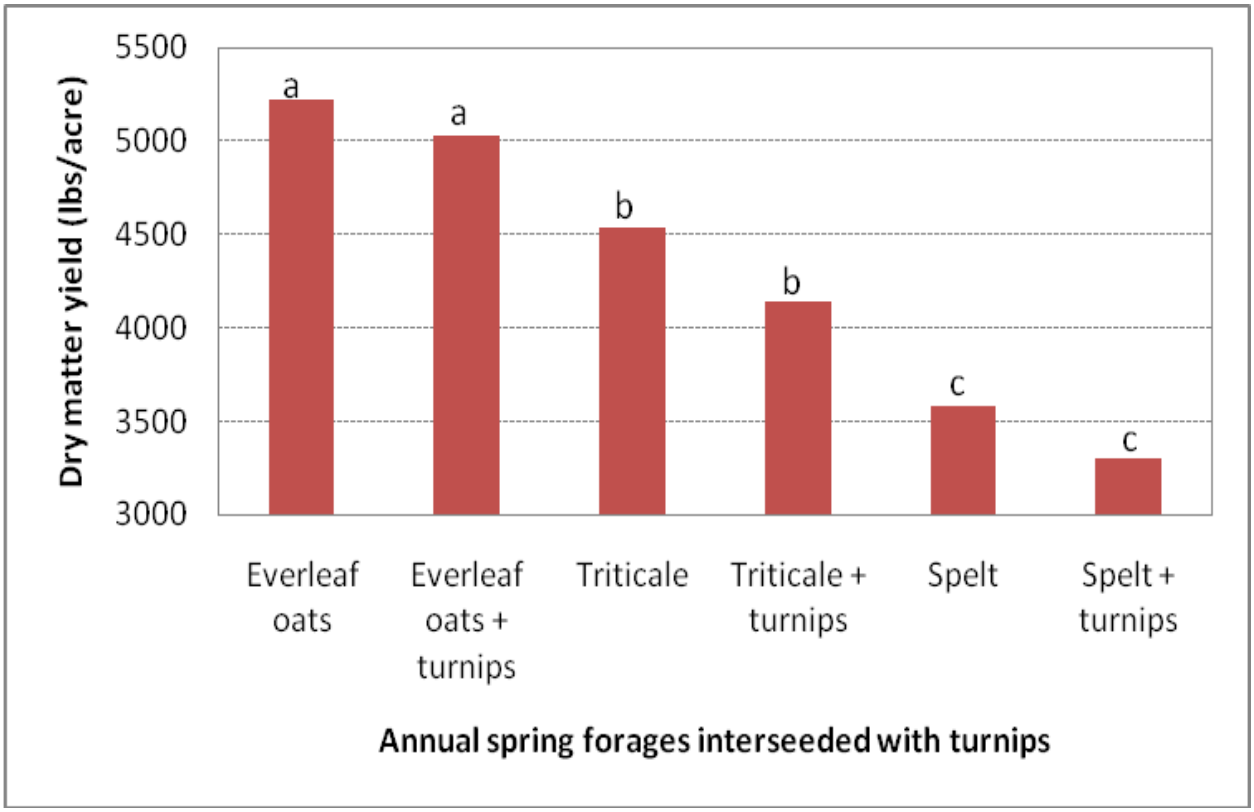

Figure 1. Dry matter yield of annual spring forages intereseeded with turnips across all harvest stages.

The spring-seeded annual were harvested at 3 developmental stages (boot, milk, and soft dough). Forages harvested in the boot stage yielded the lowest but had the highest quality feed (Table 9). The soft dough harvested grains yielded significantly higher than both milk and boot stage harvested forages. There was no significant difference in quality between milk and soft dough stages.

Table 9. Yield and quality of spring cereals interseeded with turnips at different harvest stages.

Harvest stage of annual spring forages with turnips	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Boot	14.0	2160	**19.7***	**27.9***	**41.0***	**61.2***	**63.2***	**0.66***
Milk	23.2*	5030	10.9	37.9	56.5	57.7	58.5	0.60
Soft dough	**23.7***	**5720***	11.0	36.5	54.1	49.0	58.9	0.60
LSD (0.10)	1.57	324	0.54	0.61	1.42	2.01	0.49	0.01
Means	20.3	4300	13.8	34.1	50.5	55.9	60.2	0.62

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

Each harvest time was analyzed separately to determine if the forage mixes differed in yield and quality by harvest time. When harvested at the boot stage, there was no significant difference in yield among the treatements (Table 10). The forage treatments did not differ in CP. The 'Everleaf" oats resulted in the highest NeL.

Table 10. Yield and quality of spring cereals with/without turnips harvested at the boot stage.

Small grain + turnips **boot** harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Everleaf oats	**14.9***	2010	19.1	28.0	43.9	**67.6***	**64.9***	**0.68***
Everleaf oats + Barkant turnips	12.1	2380	**20.9**	27.4*	41.0	64.8*	63.7*	0.66
Spelt	14.2*	1820	19.8	27.7*	38.9	57.6	62.1	0.64
Spelt + Barkant turnips	13.4	1760	19.6	**26.3***	**34.5***	53.8	62.5	0.65
Triticale	14.2*	2360	19.7	29.2	43.7	62.3*	62.7	0.65
Triticale + Barkant turnips	14.8*	**2590**	18.9	29.0	43.6	60.8	63.4	0.65
LSD (0.10)	0.78	NS	NS	1.41	3.36	5.69	1.43	0.02
Means	14.0	2160	19.7	27.9	41.0	61.2	63.2	0.66

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

When harvested in the milk stage, triticale yielded over 3 tons of dry matter per acre. The 'Everleaf' oats did not differ significantly in yield from the triticale or the 'Everleaf' oats mixed with turnips (Table 11; Figure 2). In general for each grain species, CP was increased when grown with forage turnips.

Table 11. Yield and quality of spring cereals with/without turnips harvested at the milk stage.

Small grain + turnips **milk** harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Everleaf oats	19.2	5790*	11.1*	39.6	62.3	60.4*	57.5	0.59
Everleaf oats + Barkant turnips	19.1	5110	**11.6***	37.5*	56.3	**62.4***	58.3	0.60
Spelt	26.8*	4450	9.20	39.0	59.7	54.4	58.4	0.60
Spelt + Barkant turnips	21.7	3780	10.9*	**36.3***	**51.4***	60.0*	58.9	**0.61**
Triticale	**28.3***	**6470***	10.7	38.3*	57.1	52.0	58.8	0.60
Triticale + Barkant turnips	24.2	4600	**11.6***	36.4*	52.3*	57.0	**59.2**	0.60
LSD (0.10)	3.67	918	0.77	2.03	3.43	4.00	NS	NS
Means	23.2	5030	10.9	37.9	56.5	57.7	58.5	0.60

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

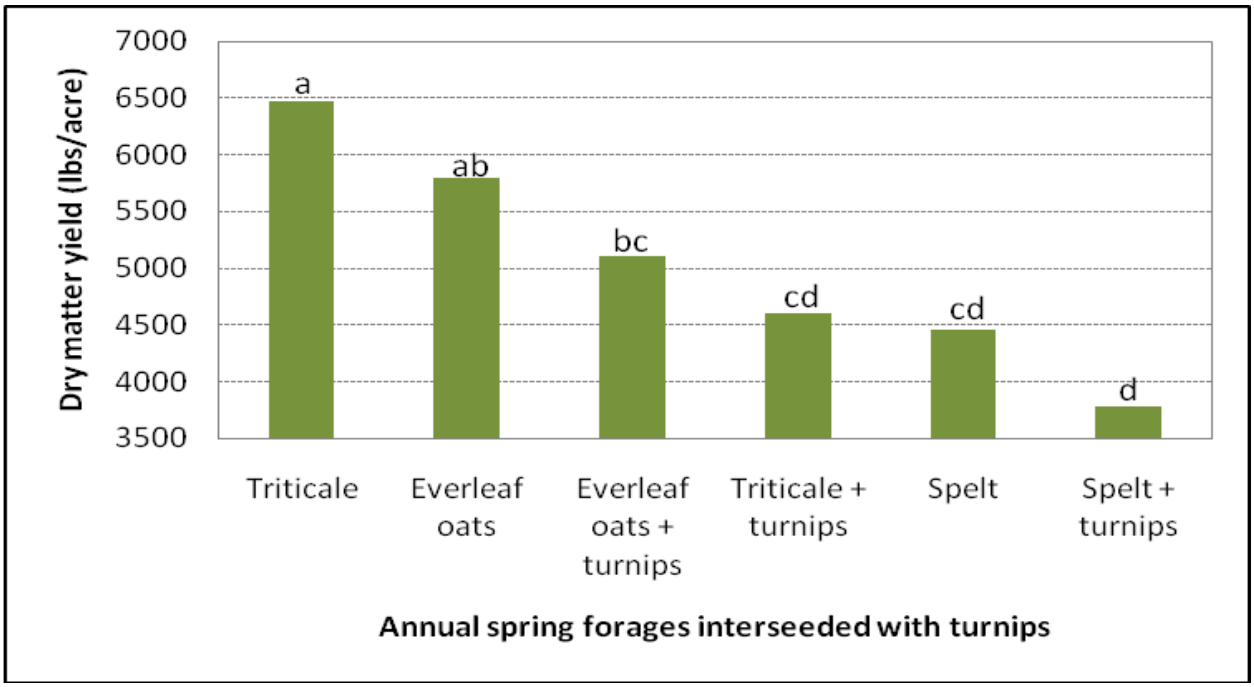

Figure 2. Yield of annual spring forages intereseeded with turnips at the milk stage.

The 'Everleaf' oats seeded with and without turnips yielded significantly higher than the other treatments. (Table 12; Figure 3) The oats were producing on average 3.9 dry tons per acre while the spelt and triticale treatments were yielding an average of 2.4 tons per acre. The triticale alone had a CP concentration of 12.5%, which was 1 to 2-percentage point higher than the other treatments. Triticale and the spelt with turnips resulting in the highest quality forage when harvested in the boot stage.

Table 12. Yield and quality of spring cereals with/without turnips harvested at soft dough stage.

Small grain + turnips **soft dough** harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Everleaf oats	25.6	**7850***	10.5	37.8	60.0	46.5	58.8	0.60
Everleaf oats + Barkant turnips	22.1	7600*	10.8	38.4	59.8	46.7	58.2	0.60
Spelt	21.9	4470	10.7	37.0	51.6*	51.2*	57.5	0.58
Spelt + Barkant turnips	24.6	4350	11.0	35.1	**49.6***	50.6*	59.7*	0.61*
Triticale	21.1	4780	**12.5***	**33.3***	49.9*	**52.7***	**60.5***	**0.62***
Triticale + Barkant turnips	**26.9**	5240	10.5	37.1	54.0	46.1	58.4	0.60
LSD (0.10)	NS	935	0.87	1.13	2.41	3.14	0.84	0.01
Means	23.7	5720	11.0	36.5	54.1	49.0	58.9	0.60

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

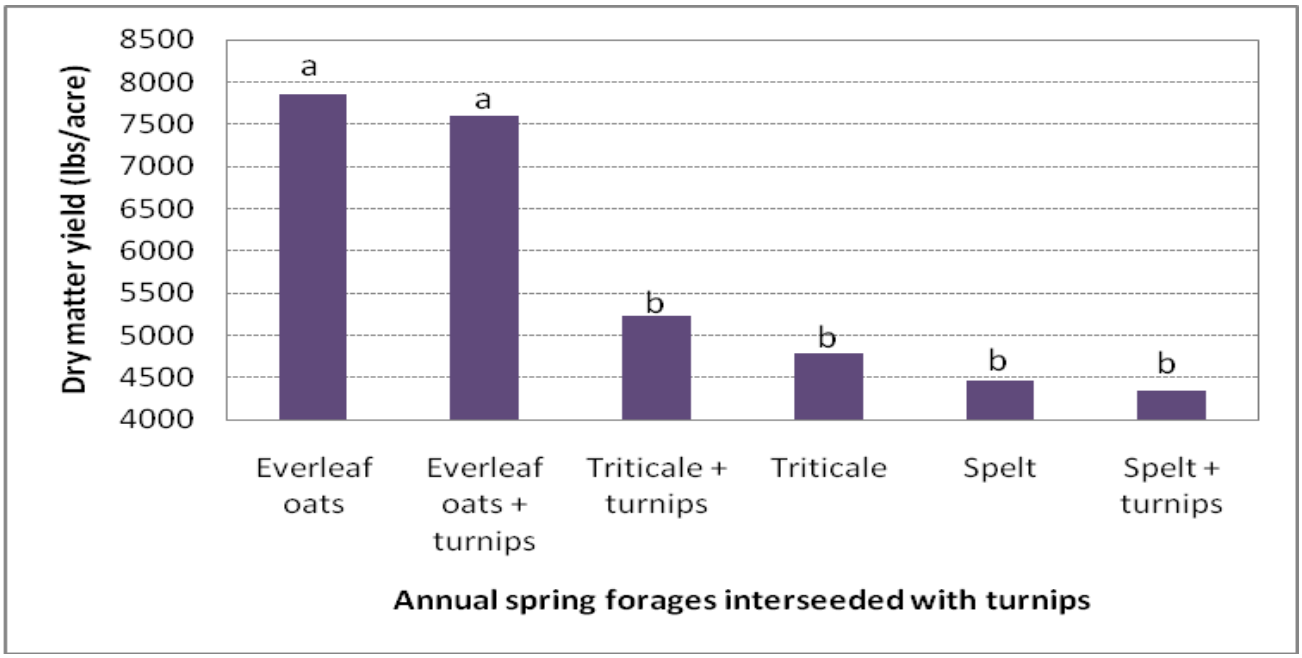

Figure 3. Yield of annual spring forages intereseeded with turnips at the soft dough stage.

An analysis was conducted to compare if the addition of turnips could improve yield and quality of spring-seeded cereals. The analysis is a simple contrast that evaluated annual spring forage with turnips and without turnips average across the cereal grain species. In the boot stage, there was no yield or quality benefit to adding forage turnips to the mix (Table 13).

Table 13. Yield and quality of spring cereals with/without turnips harvested at the boot stage.

Boot harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Annual spring forage, no turnips	**14.4**	2070	19.5	28.3	42.2	**62.5**	**63.2**	**0.66**
Annual spring forage + turnips	13.5	**2240**	**19.8**	**27.6**	**39.7**	59.8	**63.2**	0.65
LSD (0.10)	0.85	NS	NS	NS	NS	NS	NS	NS
Means	14.0	2160	19.7	27.9	41.0	61.2	63.2	0.66

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

When harvested in the milk stage, adding turnips to the cereal grains resulted in a 1000 lb decrease in dry matter yield (Table 14). Adding turnips to spring-seeded cereals did result in improved forage quality when harvested in the milk stage.

Table 14. Yield and quality of spring cereals with/without turnips harvested at the milk stage.

Milk harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Annual spring forage, no turnips	**24.8**	**5570**	10.3	39.0	59.7	55.6	58.2	0.59
Annual spring forage + turnips	21.7	4500	**11.4**	**36.7**	**53.3**	**59.8**	**58.8**	**0.60**
LSD (0.10)	3.46	795	0.69	1.09	2.58	3.37	NS	0.01
Means	23.2	5030	10.9	37.9	56.5	57.7	58.5	0.6

* Treatments that are not significantly different than the top performing treatment are indicated with an asterisk.
NS – None of the treatments were significantly different from one another.

If the annual spring forages were harvested at the soft dough stage, interseeding with turnips did not significantly impact yield or quality (Table 15).

Table 15. Yield and quality of spring cereals with/without turnips harvested at soft dough stage.

Soft dough harvest	DM at harvest	DM yield	Forage quality characteristics					
			CP	ADF	NDF	dNDF	TDN	NEL
	%	lbs/ac	%	%	%	%	%	Mcal/lb
Annual spring forage, no turnips	22.9	5700	**11.2**	**36.0**	**53.8**	**50.1**	**58.9**	**0.60**
Annual spring forage + turnips	**24.5**	**5730**	10.8	36.9	54.5	47.8	58.8	**0.60**
LSD (0.10)	NS	NS	NS	NS	NS	NS	NS	NS
Means	23.7	5720	11.0	36.5	54.1	49.0	58.9	0.60

NS – None of the treatments were significantly different from one another.

DISCUSSION

Spring-seeded cereal grains have the potential to provide a high yield and quality forage crop. From the trial it clear that forage oat varieties will outperform grain oat varieties in both forage yield and quality. It will be important for farmers to request forage types to be able to obtain the yields and quality desired for livestock. Interestingly the forage oats also remained in the vegetative stage longer than the other cereals evaluated. This would for more leafy vegetative growth and higher quality forage over a longer span of time. Similar to other trials barley consistently produced highly digestible forage throughout its developmental stages. It remains to be one of the best cereals to plant and harvest for forage. Similar to other forages, harvesting prior to flowering can result in high protein and low fiber feed. However the yields will be lower than harvesting more mature feed. The stage of harvest will be based on the forage goals and needs of the farm. Later harvested barley forage still had similar fiber contents to average quality cool season perennial grasses. Adding turnips to the cereal grain had the most benefit for later harvested cereals grains. Addition of turnips to the cereals harvested a boot stage did not result in quality increases. However, in the milk stage the turnips helped to boost the overall quality of the feed. When a grain is in the milk stage it is generally at its lowest quality levels. At this stage the brassica would help to improve the quality of the feed. Further information needs to be gathered to determine the economic benefit of adding brassica to the forage mix.

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