



# 2010 Winter Cereals as a Multipurpose Crop



Winter cereal grains ready for grazing on April 12, 2010.

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In 2010, the University of Vermont Extension continued their research evaluating winter cereals as a multipurpose crop. Winter cereal grains including barley, wheat, and triticale are planted mid to late September in the Northeast. The crops can be harvested as pasture, stored feed, or grain and straw. This study was to evaluate if the winter cereals could be grazed and then harvested for forage or grain/straw. This would allow a farmer to harvest more than one type of feed from only one planting of cereals. Overall the 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 annual forages. Winter cereals begin to grow early in the spring when air temperatures are in the low 40s. The growth of cereal grains begins before cool season pasture. Hence these cereals may provide early season grazing opportunities and then still be able to provide later harvested stored feed or even grain/straw.

### TESTING PROCEDURE

The goal of this project was to evaluate yield and quality of winter cereals for grazing, forage, and grain/straw. The plots (5' x 20') were planted on August 27, 2009. The cereal grain treatments included barley, triticale, and two varieties of wheat (Zorro and Maxine). See Table 1.

**Table 1. Winter cereal grain variety and source.**

Company	Type	Variety
C & M Seeds	Wheat	Maxine
C & M Seeds	Wheat	Zorro
SeedWay Seeds	Barley	Thoroughbred
SeedWay Seeds	Triticale	Trical336

The plots were “grazed” with the sickle bar mower on April 23, 2010 at an average height of 13”. These plots were then either 1) regrazed (May 7<sup>th</sup>), 2) harvested for forage at the boot stage (May 17<sup>th</sup> for the barley, May 20<sup>th</sup> for the triticale, and May 24<sup>th</sup> for the wheat), or 3) harvested for grain on July 15<sup>th</sup> (only the triticale was harvested due to bird predation). Project details are listed in Table 2.

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 multipurpose winter grain trial.**

	Borderview Farm, Alburgh, VT
Planting date	27-Aug-2010
Seeding rate	175 lbs/ac
Graze one	23-Apr-2010
Graze two	7-May-2010
Forage harvest (barley boot stage)	17-May-2010
Forage harvest (triticale boot stage)	20-May-2010
Forage harvest (wheat boot stage)	24-May-2010
Grain harvest (triticale only)	17-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

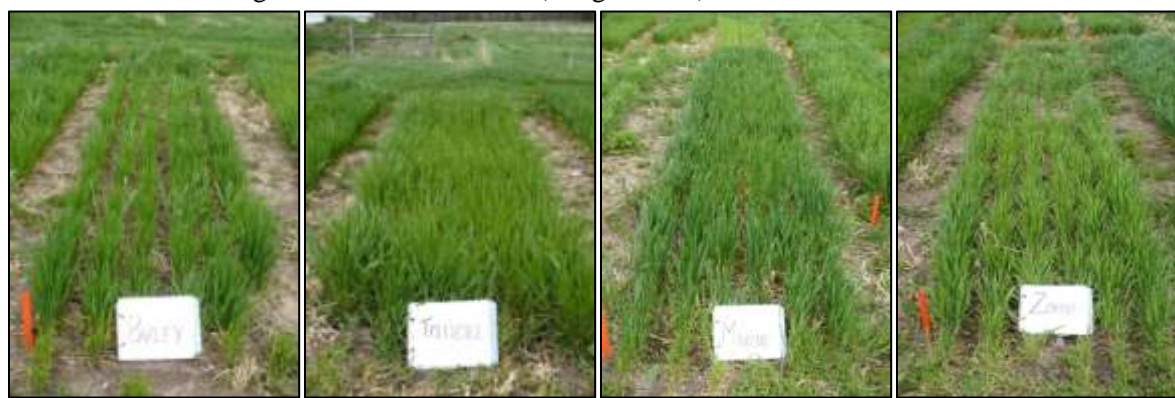
Silage quality was analyzed by Cumberland Valley Analytical Forage Laboratory in Hagerstown, Maryland. Plot samples were dried, ground and analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and various other nutrients. The Nonstructural Carbohydrates (NSC) and 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

### *Winter Cereals as a Multipurpose Crop*

The barley experienced the most winter kill and had a 75% survival rate, compared to the wheat and triticale, which averaged a 92% survival rate (Images 1 – 4).



**Image 1. Winter barley spring growth.**

**Image 2. Winter triticale spring growth.**

**Image 3. Winter wheat, Maxine, spring growth.**

**Image 4. Winter wheat, Zorro, spring growth.**

When evaluating the main effect of cereal grain species there was no significant difference in yield. However, barley far out performed other grains in quality (Table 4). Interesting, the wheat variety Maxine was higher in protein than Zorro. This may indicate that variety selection is important even when grains are harvested in the vegetative stages for forage and pasture production.

**Table 1. Mean yield and quality of winter grains harvested with different strategies.**

Small grain	DM at harvest %	DM yield lbs/ac	Forage quality characteristics						
			CP %	ADF %	NDF %	dNDF %	TDN %	NSC %	NEL Mcal/lb
Zorro	<b>22.8*</b>	<b>1810</b>	16.5	27.8	46.7	72.0	64	15.7	0.66
Triticale	21.5	1760	17.1	27.2	47.0	70.2	64.4	16.5*	0.66
Maxine	22.6*	1710	18.6*	28.5	47.4	70.0	62.6	13.8	0.65
Barley	20.1	1330	<b>18.9*</b>	<b>24.5*</b>	<b>40.9*</b>	<b>75.3*</b>	<b>66.3*</b>	<b>17.2*</b>	<b>0.69*</b>
LSD (0.10)	0.84	NS	1.53	0.87	1.47	1.91	0.83	0.92	0.01
Means	21.7	1650	17.8	27.0	45.5	71.9	64.3	15.8	0.67

\* Treatments that did not perform significantly lower than the top performing treatment in a particular column are indicated with an asterisk.

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

When evaluating the effect of harvest time, the first graze gave the lowest yield but highest quality (Table 5). The second graze yielded slightly higher but the fiber content began to increase while the fiber digestibility declined significantly compared to graze 1. The forage harvest in the boot stage resulted in the highest yields but lowest quality forage (Table 5).

**Table 2. Dry matter yield and quality of winter cereal grain harvest strategies.**

Harvest stage	DM at harvest %	DM yield lbs/ac	Forage quality characteristics						
			CP %	ADF %	NDF %	dNDF %	TDN %	NSC %	NEL Mcal/lb
Graze 1	<b>24.4*</b>	899	19.3*	<b>22.6*</b>	<b>37.3*</b>	<b>83.4*</b>	<b>66.3*</b>	<b>18.9*</b>	<b>0.69*</b>
Graze 2	19.3	1130	<b>20.4*</b>	27.8	47.3	65.6	62.0	13.4	0.64
Forage	21.5	<b>2930*</b>	13.6	30.6	51.9	66.5	64.7	15.1	0.67
LSD (0.10)	0.73	375	1.32	0.76	1.27	1.66	0.72	0.79	0.01
Means	21.7	1650	17.8	27.0	45.5	71.9	64.3	15.8	0.67

\* 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 grain species differed in yield and quality. During the first graze the triticale out yielded wheat and barley (Table 6). Barley had significantly lower fiber content than both triticale and wheat. There was no difference in quality among triticale or wheat species.

**Table 6. Dry matter yield and quality of winter cereal grains first grazing.**

Small grain	DM at harvest %	DM yield lbs/ac	Forage quality characteristics						
			CP %	ADF %	NDF %	dNDF %	TDN %	NSC %	NEL Mcal/lb
Barley	<b>21.7*</b>	267	<b>21.5</b>	<b>20.8*</b>	<b>32.5*</b>	<b>85.7</b>	<b>67.1</b>	19.1	<b>0.70</b>
Maxine	25.7	802	20.3	23.4	39.1	79.7	64.6	17.8	0.67
Triticale	25.1	<b>1887*</b>	17.3	23.5	38.8	83.3	67.0	<b>19.7</b>	<b>0.70</b>
Zorro	25.3	638	18.1	22.8	38.7	84.9	66.6	19.0	0.69
LSD (0.10)	1.99	887	NS	1.92	2.28	NS	NS	NS	NS
Means	24.4	899	19.3	22.6	37.2	83.4	66.3	18.9	0.69

\* 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.

The plots were first “grazed” on April 23, 2010 at an average height of 13”. These plots were then either 1) regrazed (May 7<sup>th</sup>), 2) harvested for forage at the boot stage (May 17<sup>th</sup> for the barley, May 20<sup>th</sup> for the triticale, and May 24<sup>th</sup> for the wheat), or 3) harvested for grain on July 15<sup>th</sup> (only the triticale was harvested due to bird predation). The yield and quality of cereal grains at the second graze are shown in Table 7. The yield and quality of forage harvested in the boot stage is shown in Table 8. At the second grazing, the wheat and barley out yielded the triticale. The fiber concentration was significantly lower in

the barley than triticale and wheat. Interestingly, during the second graze the fiber digestibility was lowest in the triticale. When the second harvest of forage occurred at the boot stage there was no significant difference among yields between the cereal grains (Table 8). However, barley clearly outperformed both the wheat and triticale in overall quality. Grain yields were only harvested for the triticale due to bird predation in the other grain plots. The yield of triticale grain was 1775 lbs per acre. The straw yield was an average of 2550 lbs per acre.

**Table 7. Dry matter yield and quality of winter cereal grains second grazing.**

Small grain	DM at harvest	DM yield	Forage quality characteristics						
			CP	ADF	NDF	dNDF	TDN	NSC	NEL
	%	lbs/ac	%	%	%	%	%	%	Mcal/lb
Barley	<b>18.1</b>	1068*	20.9	<b>25.9*</b>	<b>43.1*</b>	<b>66.9*</b>	<b>63.7*</b>	<b>15.8*</b>	<b>0.66*</b>
Maxine	19.3	1250*	<b>21.9</b>	28.6	47.8	65.7*	60.5	11.00	0.62
Triticale	19.3	899	19.2	28.1	49.0	64.0	62.5	14.1*	0.64
Zorro	20.5	<b>1305*</b>	19.6	28.6	49.2	65.9*	61.4	12.70	0.63
LSD (0.10)	NS	291	NS	1.59	3.84	1.85	0.79	2.00	0.001
Means	19.3	1130	20.3	27.7	47.3	65.6	62.0	13.4	0.63

\* 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.

**Table 8. Dry matter yield and quality of winter cereal grains harvested in the boot stage.**

Small grain	DM at harvest	DM yield	Forage quality characteristics						
			CP	ADF	NDF	dNDF	TDN	NSC	NEL
	%	lbs/ac	%	%	%	%	%	%	Mcal/lb
Barley	20.4*	2648	14.1*	<b>26.9*</b>	<b>47.0*</b>	<b>73.2*</b>	<b>68.1*</b>	<b>16.8*</b>	<b>0.71*</b>
Maxine	22.8	3088	13.6*	33.4	55.1	64.7	62.9	12.4	0.65
Triticale	<b>20.1*</b>	2490	<b>14.9*</b>	30.1	53.2	63.2	63.7	15.8*	0.66
Zorro	22.8	<b>3485</b>	11.8	32.0	52.3	65.1	64.1	15.4*	0.67
LSD (0.10)	1.44	NS	1.65	1.16	1.84	1.62	0.85	1.46	0.013
Means	21.5	2927	13.6	30.6	51.9	66.5	64.9	16.8	0.67

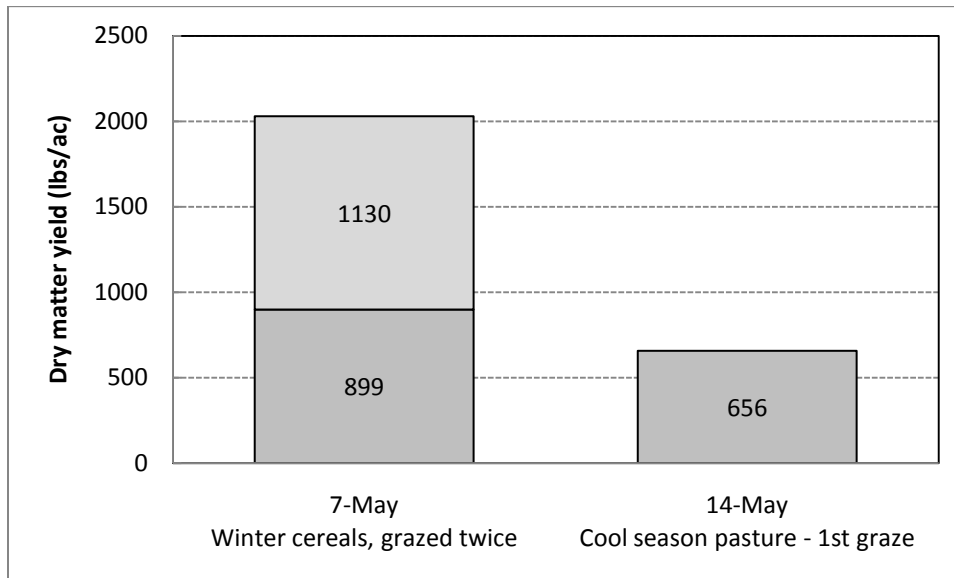
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## DISCUSSION

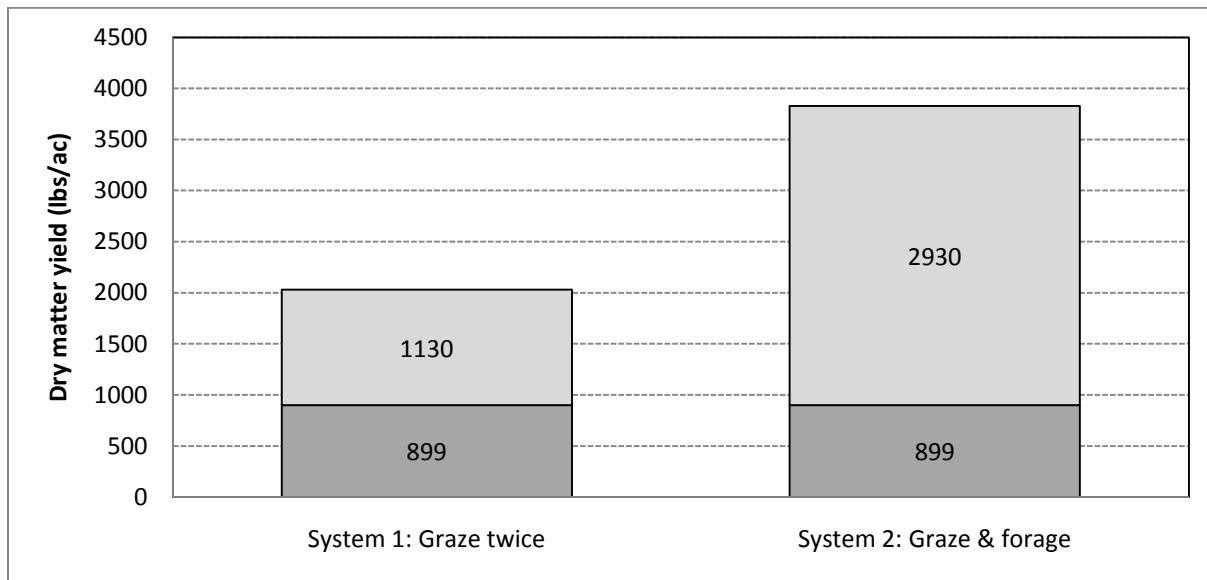
Based on the small plot research with simulated grazing there is a potential to take multiple harvests from one planting of fall seeded cereal grains. However, on-farm trials indicate that multiple harvests will be completely dependent on the weather conditions at the time of the first grazing. Like success of most practices in farming weather plays a significant role in the outcome. The positive aspects are that a

significant quantity of high quality forage can be harvested as pasture approximately 2 weeks before the perennial cool season pasture is ready to graze. This will potentially help farmers get the cows out of the barn earlier and onto fresh forage. This could ultimately reduce production costs.



**Figure 1. Early season grazing on winter cereals vs. cool season pasture.**

If a second harvest of forage is possible it is possible to graze, harvest stored feed, or even take the crop to grain and straw harvest. The decision of what type of feed to harvest will depend somewhat on the forage goals and need of the farm. If we are evaluating the individual systems the research indicates that higher total yields per acre can be obtained if the forage is grazed and a second harvest is made in the boot stage (Figure 2). When comparing the grain species, the data indicates that barley will provide the highest quality feed under all cropping systems. However, it can be difficult to overwinter and may not be appropriate for all climates. Both the triticale and wheat had similar forage quality and would be a good alternative for cold winter climates. The triticale does mature earlier than wheat and might provide earlier grazing opportunities compared to wheat. Overall, fall seeded cereals can provide high quality pasture and stored feed and should be considered as potential forage crops for the Northeast.



**Figure 2. Dry matter yield of the winter cereal cropping systems.**

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