2012 Small Grain Forage Trial

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INTRODUCTION

Spring cereal grains such as oats, barley, triticale and wheat can have the potential to provide high yield and quality feed for livestock. These cool season annuals can provide early season grazing, as well as high quality stored feed. Spring grains are generally planted in mid to late April and can be harvested at various stages of development. In addition, production of high quality forage in the early season can improve the level of beneficial fats (i.e. Omege-3) in the milk. The objective of this project was to evaluate yield and quality of various spring grain species harvested in the vegetative, boot 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 annual forages. The data presented here is from one replicated research trial in Vermont. Crop performance data from additional tests in different locations, and often over several years, should be compared before you make conclusions. This project was supported through the Organic Valley Farmers Advocating for Organics fund.

METHODS

In 2012, a small grain forage trial was conducted at Borderview Research Farm in Alburgh, VT (Table 1). The previous crop in this location was sunflowers, and the seedbed was prepared by conventional tillage methods. The field was disked and spike-toothed harrowed in late March to prepare for planting. Plots were planted with a six-inch Kincaid cone seeder on 6-Apr at a seeding rate of 125 lbs/acre. The varieties and seed source are listed in Table 2. Each treatment was harvested at four development stages: vegetative stage, boot stage, soft dough stage and grain. Subsamples of approximately 2.5 ft^2 were cut to the ground, dried at 40^oC, and weighed to determine dry matter yield. Oven dry samples were coarsely ground with a Wiley mill (Thomas Scientific, Swedesboro, NJ) and sent to Cumberland Valley Analytical Services, Inc. (Hagerstown, MD) for quality analysis. Results were analyzed with an analysis of variance or with a Tukey-Kramer method of comparison in SAS (Cary, NC).

Table 1. General plot management.

Trial Information	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam

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 for Lactation (NEL) were calculated to determine forage value. Mixtures of true proteins, composed of amino acids and non-protein 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. Recently, forage testing laboratories have begun to evaluate forages for NDF digestibility. Evaluation of forages and other feedstuffs for NDF digestibility is being conducted to aid prediction of feed energy content and animal performance. Research has demonstrated that lactating dairy cows will eat more dry matter and produce more milk when fed forages with optimum NDF digestibility. Forages with increased NDF digestibility (dNDF)

LEAST SIGNIFICANT DIFFERENCE (LSD)

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 varieties 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. the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the example below, A is significantly different from C but not from B. The difference between A and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between A and C is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that B was not significantly lower than the top yielding variety.

[illegible]

Figure 1. Total fatty acid concentration of three small grain forage species at three harvest stages.

Harvest Stage

Comparing harvest stages, forage harvested in the soft dough stage yield

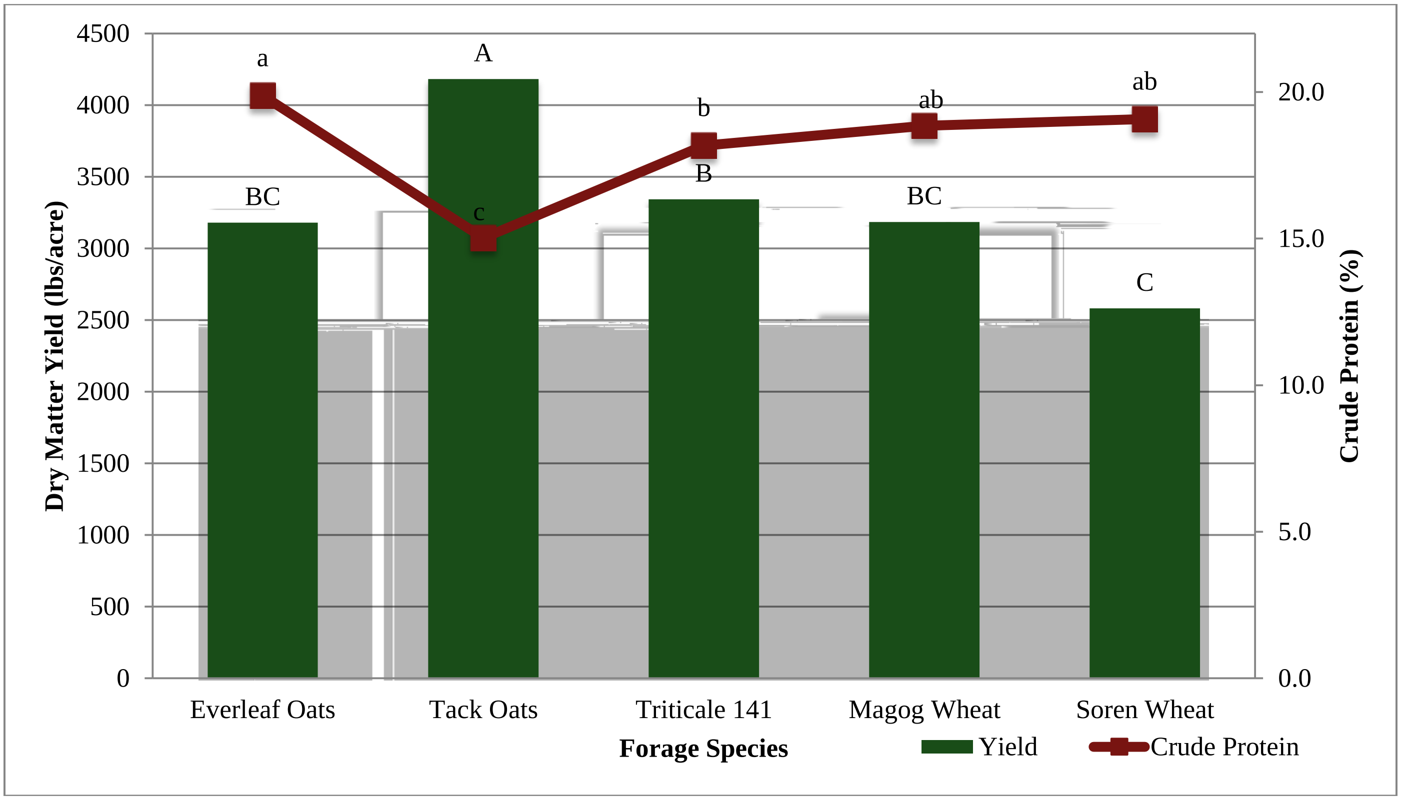

Figure 5. Yield and protein of small grain forage harvested in the vegetative stage. Treatments with the same letter did not differ significantly from one another.

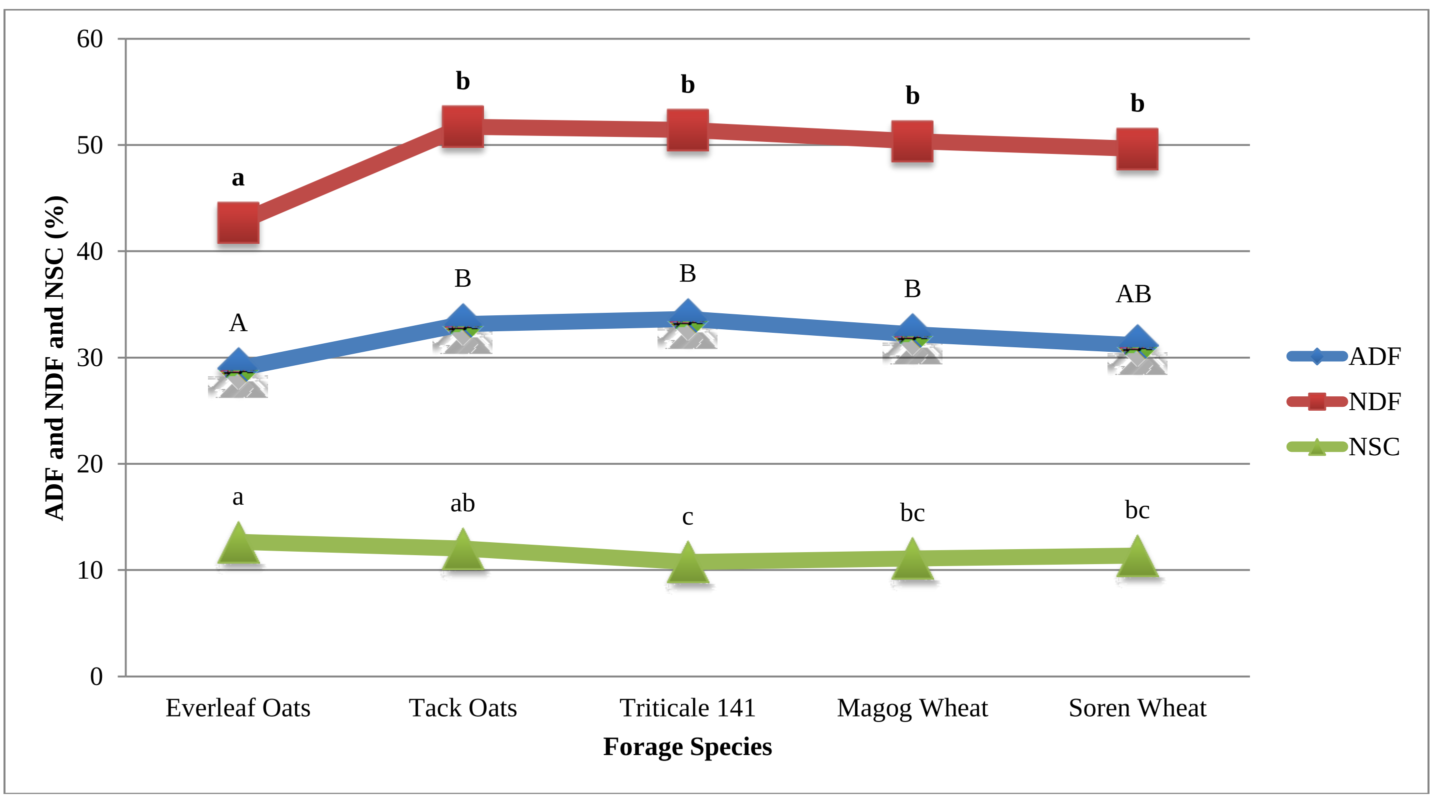

Figure 6. Acid detergent fiber (ADF), neutral detergent fiber (NDF), and non-structural carbohydrates (NSC) of small grain forage harvested in the vegetative stage. Treatments with the same letter did not differ significantly from one another.

In the vegetative stage, Everleaf oats had the highest levels of total FA 24.4 mg g^{-1} (Table 9). But the omega 3 FA

Boot Stage Harvest

In small grain development, the boot stage occurs when the grain head is just barely visible and about to emerge. Everleaf oats had the greatest dry matter yields when harvested in the boot stage, 6509 lbs dry matter $acre^{-1}$ (Table 10 and Figure 8). Soren wheat and triticale had the highest boot stage protein levels, over 16%. Traditional barley had the lowest boot stage ADF and highest digestible NDF levels (Figure 9). Soren wheat had the lowest NDF levels and highest starch, total digestible nutrients, net energy for lactation and non-fiber carbohydrates.

Table 10. Small grain forage yield and quality harvested in the boot stage, June and July 2012.

Boot Stage	DM %	Yield lb ac^{-1}	CP %	ADF %	NDF %	dNDF %	Starch %	TDN %	NEL Mcal lb^{-1}	NFC %	NSC

Figure 9. Acid detergent fiber (ADF), neutral detergent fiber (NDF), and net energy for lactation (NEL) of small grain forage harvested in the boot stage. Treatments with the same letter did not differ significantly from one another.

In the boot stage, total FA concentrations were similar across forage species (Table 11). Everleaf oats had higher levels of omega 6 FA and a higher ratio of omega 6 to omega 3 FA than wheat and triticale. The omega 3 FA profile for Everleaf oats was over 12 percentage points lower than the omega 3 profile for wheat and triticale (Figure 10).

Table 11. Average forage fatty acid profile (%- in grey) and concentration (mg g^{-1}-in white) of small grain forages harvested in the boot stage.

	Everleaf Oats	Magog Wheat	Triticale 141	Boot Mean	LSD
SFA (%)					

Figure 10. Omega 3 fatty acid profile of small grain forages harvested in the boot stage.

Soft Dough Stage Harvest

Similar to the boot stage, triticale was the highest yielding treatment when harvested during the soft dough stage (Table 12 and Figure 11). Triticale yielded close to 15,000 lbs dry matter $acre^{-1}$, which is almost 2700 lbs $acre^{-1}$ more than the next highest yielding treatment, Everleaf oats

Table 13. Average forage fatty acid profile (%- in grey) and concentration (mg g^{-1}-in white) of small grain forage

Grain Harvest

Grain was harvested on 3-Aug 2012. Soren wheat had the highest grain yields of all the species, with almost 2500 lbs acre^{-1} (Table 14, Figure 14). Both wheat varieties yielded significantly more than other species, with Traditional barley yields close behind. Soren and Magog wheat also had the highest crude protein levels, around 17%. Magog wheat had the lowest ADF and NDF, and highest starch, total digestible nutrients, net energy for lactation, non fiber carbohydrates and nonstructural carbohydrates (Figure 15). Soren wheat and Triticale 141 also had similarly high grain quality characteristics. The oats had higher fiber than the other grains due to the hulls that did not thresh freely from the grain, however this fiber was highly digestible.

Table 14. Small grain forage yield and quality of grain, August 2012.

Grain Stage	DM %	Yield lb ac^{-1}	CP	ADF	NDF	dNDF	Starch	TDN	NEL	NFC	NSC

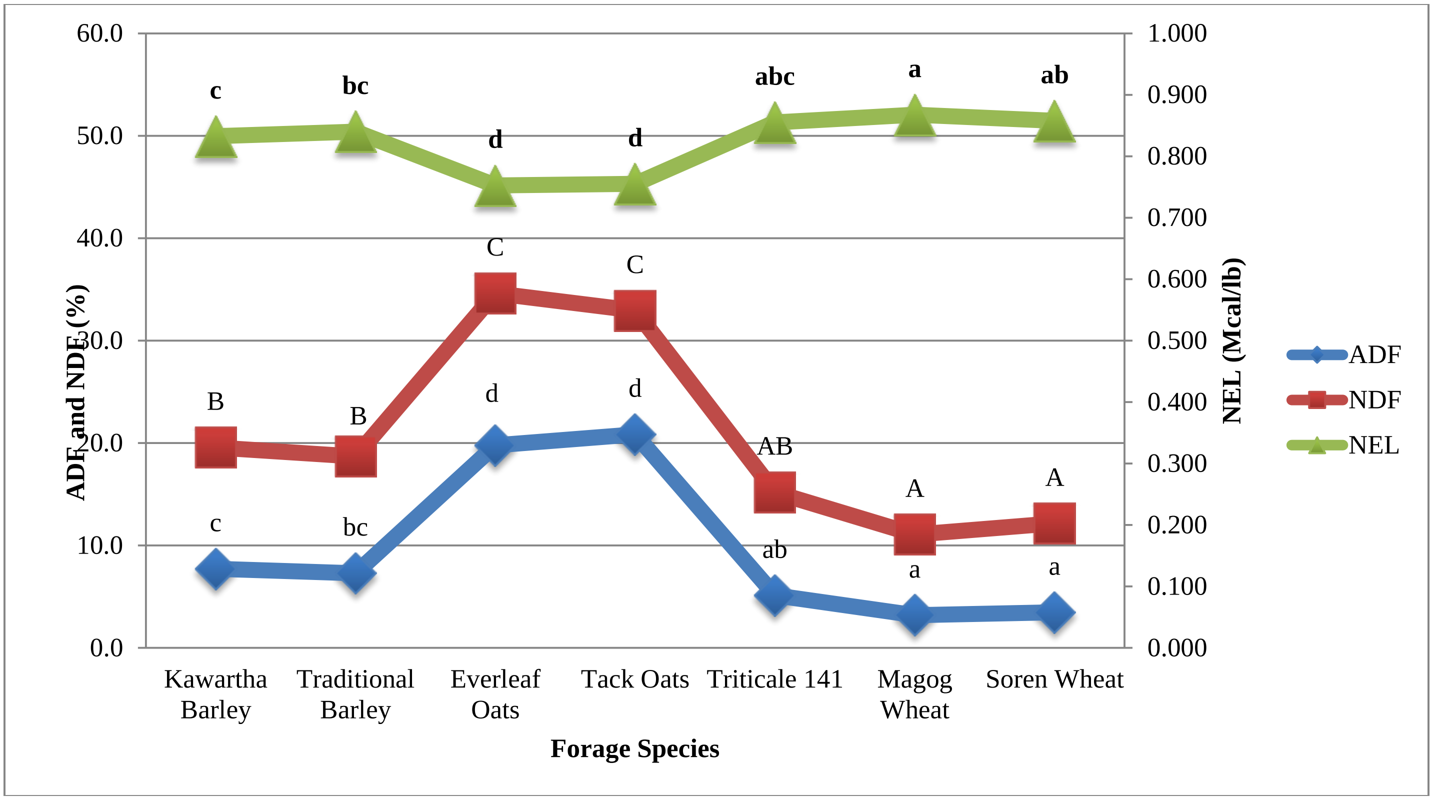

Figure 15. Acid detergent fiber (ADF), neutral detergent fiber (NDF), and net energy for lactation (NEL) of small grain forage harvested as grain. Treatments with the same letter did not differ significantly from one another.

REFERENCE

Sukhija, P. S., and D. L. Palmquist. 1988. Rapid method for determination of total fatty acid content and composition of feedstuffs and feces. *J. Agric. Food Chem.* 36: 1202 1206.

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