Evaluation of Intermediate and Tall Wheatgrass for Biomass Production in the Northeast

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Introduction

Perennial forage grasses have the potential to be utilized as a biomass fuel for heating which could displace heating oil or propane, both important petroleum products in the Northeast subject to fluctuating prices. Many marginally productive fields in the Northeast are no longer utilized for forage production but could support perennial grasses for biomass production.

As part of a Vermont and New York initiative to explore the potential of perennial grasses for biomass energy, field trials were conducted in Vermont and New York from 2009 to 2012 in order to evaluate the production, fuel quality characteristics, and sustainability of various cultivars of intermediate wheatgrass, IWG, (*Thinopyrum intermedium*) and tall wheatgrass, TWG, (*Thinopyrum ponticum*).

These grasses had not been previously evaluated in the NE because of their lack of high quality as a dairy forage. Also, there is little knowledge about their adaptation to a temperate region like the NE in terms of long term sustainability. However, they do have characteristics conducive for their use as a biomass crop including:

- High production of culms
- High stem to leaf ration
- Low mineral and ash content
- Late, single cut harvest system in late summer when it is better weather for hay

'Big Flats' Intermediate Wheatgrass

Objective

To evaluate the production potential, fuel quality characteristics, and sustainability of intermediate wheatgrass (*Thinopyrum intermedium*) and tall wheatgrass (*Thinopyrum ponticum*) grown in the Northeastern U.S.

Materials and Methods

Fields studies were planted in late summer of 2009 in South Burlington, VT, at the Un. of Vermont Horticultural Research Farm, and in Big Flats, NY at the USDA-NRCS Plant Materials Station. In Vermont, two cultivars of both IWG and TWG as well as one reed canarygrass, RCG, cultivar was planted. In New York, three cultivars of IWG and one TWG was evaluated. Both studies utilized a CRB design with four replications. Plot size was 3 x 4 m. All plots received 56 kg of N per ha each year applied in late April/early May.

Plots were harvested only once per year from 2010 to 2012 and harvest dates varied but ranged from late July to October. A Carter research forage harvester was used to determine biomass yields cutting a 0.9 m strip out of each plot. A subsample was collected to determine dry matter content and used for ash and mineral analysis.

Before harvest, plots were visually rated for stand density, lodging, foliar disease and weeds. Data for 2012 in NY was not available at the time of this presentation.

Results

- Overall yields were comparable in both locations and usually there were no differences in yield between cultivars or species (Table 1 and 2).
- In VT, yields were similar to reed canarygrass which is a very common grass that is found in marginal sites

Table 1. Biomass yield of cool season grasses, South Burlington, Vermont. Planted on 8/18/2009. Soil type - Adams sandy loam

		Biomass Yield		
Species	Cultivar	2010	2011	2012
		----- *MT d.m. ha^{-1}* -----		
Inter. wheatgrass	Big Flats	5.4 a[3]	8.2	7.7
Inter. wheatgrass	Haymaker	5.0 a	7.4	7.1
Inter. wheatgrass	Beef Maker	5.0 a	8.2	8.0
Tall wheatgrass	Alkar	3.8 b	8.6	7.8
Tall wheatgrass	Largo	3.8 b	8.4	6.8
Reed canarygrass	Palaton	4.5 ab	8.1	6.6
Significance[2]		#	n.s.	n.s.

[1] Harvest dates were 7/29/10, 8/2/11, and 8/7/12
[2] Significance: # - P<0.10, * - P<0.05, ** - P<0.01
[3] Means with the same letter are not significantly different (P<0.10)

Table 2. Biomass yield of cool season grasses, Big Flats, NY. Planted on 8/28/2009. Soil type - Unadila silt loam

		Biomass Yield	
Species	Cultivar	2010	2011
		----- *MT d.m. ha^{-1}* -----	
Inter. wheatgrass	Big Flats	7.1	7.0
Inter. wheatgrass	Haymaker	6.9	7.4
Inter. wheatgrass	Beef Maker	6.0	6.7
Inter. wheatgrass	Oahe	6.2	6.8
Tall wheatgrass	Alkar	6.9	7.4
Significance[2]		n.s.	n.s.

[1] Harvest dates were 8/30/10 and 10/10/11
[2] Significance: # - P<0.10, * - P<0.05, ** - P<0.01

- Ash content was consistently lower for the IWG cultivars as well as 'Largo' TWG compared to RCG (Table 3).
- 'Alkar' TWG was numerically lower but not significantly different than RCG in two of the three years.
- RCG was much higher in 2010 and 2012 probably because of a large proportion of non-culmed tillers compared to 2011.

Table 3. Ash content of cool season grasses harvested over three years in South Burlington, Vermont.

		Ash Content		
Species	Cultivar	2010	2011	2012
		----- *g kg^{-1}* -----		
Inter. wheatgrass	Big Flats	52.0 bc[3]	34.0 bc	32.3 b
Inter. wheatgrass	Haymaker	49.0 c	33.0 bc	35.0 b
Inter. wheatgrass	Beef Maker	51.0 bc	29.0 c	31.8 b
Tall wheatgrass	Alkar	61.0 ab	38.0 ab	43.5 b
Tall wheatgrass	Largo	55.0 bc	33.0 bc	40.5 b
Reed canarygrass	Palaton	71.0 a	43.0 a	69.3 a
Significance[2]		**	**	***

[1] Harvest dates were 7/29/10, 8/2/11, 8/7/12
[2] Significance: # - P<0.10, * - P<0.05, ** - P<0.01
[3] Means with the same letter are not significantly different (P<0.05)

- Nitrogen content was all below 10 g ha^{-1} (Table 4).
- Potassium levels were generally low for cool season grasses. IWG was lower than TWG and RCG.
- The IWG cultivars and 'Largo' TWG had significantly lower sulfur content compared to .RCG

Table 4. Mineral content of cool season grasses at harvest in 2011, South Burlington, Vermont. Planted on 8/18/2009. Soil type - Adams sandy loam

Species	Cultivar	N	K	S
			----- *g kg^{-1}* -----	
Inter. wheatgrass	Big Flats	8.5	9.7 abc[3]	0.7 bc
Inter. wheatgrass	Haymaker	8.8	9.3 bc	0.9 bc
Inter. wheatgrass	Beef Maker	7.5	8.1 c	0.6 c
Tall wheatgrass	Alkar	9.7	12.3 a	1.1 ab
Tall wheatgrass	Largo	9.0	10.5 abc	0.9 bc
Reed canarygrass	Palaton	8.0	11.3 ab	1.5 a
Significance[2]		n.s.	**	***

[1] Harvest date was 8/2/2011
[2] Significance: # - P<0.10, * - P<0.05, ** - P<0.01
[3] Means with the same letter are not significantly different (P<0.05)

- In two of the three years in Vermont, lodging was a problem (Table 5); however, there was no to little lodging in New York
- The IWG cultivars generally had amounts of lodging compared to RCG in two of the three years; whereas, TWG only had higher amounts of lodging in one year, 2011.
- There appeared to be no relationship between lodging and ash content indicating no soil contamination during harvest

Table 5. Lodging ratings of plots in South Burlington, VT.

		Lodging[1]		
Species	Cultivar	2010	2011	2012
Inter. wheatgrass	Big Flats	1.0 b[3]	3.4 a	3.1 ab
Inter. wheatgrass	Haymaker	1.0 b	3.0 a	3.8 a
Inter. wheatgrass	Beef Maker	1.0 b	2.9 a	2.3 ab
Tall wheatgrass	Alkar	1.0 b	2.5 ab	1.3 b
Tall wheatgrass	Largo	2.0 a	3.0 a	1.5 b
Reed canarygrass	Palaton	1.0 b	1.0 b	1.5 b
Significance[2]		*	*	**

[1] Visual rating of the whole plot from 1 (none) to 5 (completely lodged)
[2] Significance: # - P<0.10, * - P<0.05, ** - P<0.01
[3] Means with the same letter are not significantly different (P<0.05)

A lodged plot of intermediate wheatgrass in 2011 compared to non-lodged reed canarygrass

- It is too early to determine how well stands will persist over time. An earlier study in NY indicated yields dropped after four years.
- The Vermont plots appeared to be thinning in 2012. A stand assessment will be made in 2013

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For more information on grass energy research in Vermont and New York, go to http://pss.uvm.edu/vtcrops/?Page=energycrops.html