Mulch Hay for Combustion in NYS

Purpose: The purpose of this publication is to describe the range in composition of mulch-type hay in NYS as a combustion feedstock.

Introduction

There are approximately 1.5 to 2 million acres of unused or underutilized grass meadows in NYS. If these fields are not too far along the path of woody succession, they can be mowed and baled. The economic feasibility of this depends on the yield per acre, and the size (efficiency) of the harvesting equipment. Abandoned fields tend to revert to a more rugged terrain over time, so harvest of some of these fields may be problematic.

Fig. 1. Mulch hay in NYS is typically harvested from marginal lands that have no fertility management program.

What is "Mulch Hay"?

Mulch-type hay is defined as any baled hay that is produced from mature grass, straw or stover. Fields are typically unimproved, with mixtures of grasses and often weeds, occasionally some small woody plants. These fields are harvested once annually, sometime between July and October. Yields from such fields are generally low, around two tons/acre.

What Happens to Mulch Hay?

Most mulch hay in NYS is transported to Pennsylvania and used as mushroom compost. Hundreds of truckloads (54 large square bales or about 24 tons per load) of mulch hay are sent south annually. Recently some of this hay has been redirected to cattle forage markets, due to shortages of forage crops.

Fig. 2. Large square bales of mature mixed grass hay in northern NY waiting to be transported to Pennsylvania for use as mushroom compost.

Sampling

Lots of mature mulch-type hay were identified across NYS in 2011 and 2012. Most of these lots were destined for the mushroom mulch market, although a few were fed to beef cattle. Most were large square bales, with some round bales, and a few small square bales. Ten bales from each lot of hay were cored, with 3-6 cores per bale. Lots of hay samples were composited and were analyzed for biomass parameters, as well as some individual bales.

Table 1. Average content of 200 mulch hay lots sampled in NYS in 2011 and 2012. Each lot sample was a 10-bale composite, for a total of 2,000 bales sampled.

Variable	Mean	Min	Max
Ash, %	7.02	3.81	11.69
Cl, %	0.25	0.07	0.90
K, %	1.11	0.12	2.47
N, %	1.53	0.59	2.55
S, %	0.13	0.06	0.32
BTU, per lb	8065	7553	8408
ADF, %	46.1	34.66	60.27
NDF, %	66.4	53.3	88.6
Lignin, %	8.69	5.12	14.1
P, %	0.15	0.02	0.39
Ca, %	0.49	0.16	0.98
Na, ppm	169	52	1175
Al, ppm	272	48	3076
Fe, ppm	245	54	2487
Ti, ppm	6.4	0.4	114

Results

Composite hay lot samples (Table 1) were relatively high in ash, Cl, N, and K, although the range in content was very large. If this hay was used for light industrial scale combustion, the composition may not be unreasonable. If used for residential scale pellet combustion, however, there probably would need to be standards established for the feedstock (Cherney and Verma, 2013).

Table 2. Contents of one mulch hay lot sampled in Jefferson County, NY in 2011. Each of the 10 bales in this lot were analyzed separately.

Variable	Mean	Min	Max
Ash, %	10.8	6.5	33.4
Cl, %	0.20	0.08	0.53
K, %	1.27	0.73	1.56
N, %	1.54	1.45	1.73
S, %	0.16	0.10	0.23
BTU, per lb	7703	5645	8130
ADF, %	46.1	43.4	53.4
NDF, %	65.1	62.4	69.8
Lignin, %	8.00	7.27	8.92
P, %	0.15	0.08	0.22
Ca, %	0.52	0.39	0.67
Na, ppm	202	113	568
Al, ppm	1865	146	14,890
Fe, ppm	1733	113	13,860
Ti, ppm	73	3.7	566

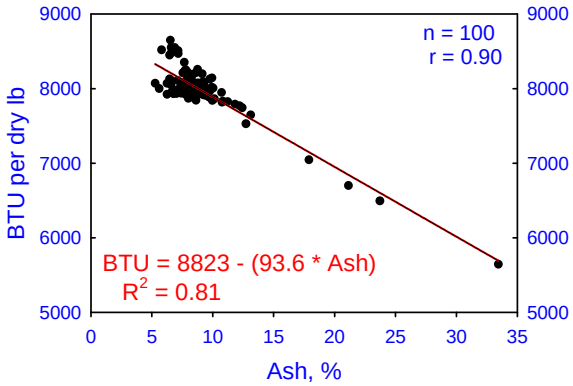

Fig. 3. Relationship between ash and BTU for individual mulch hay bales in NYS in 2011.

Individual bales from some lots were analyzed separately; Table 2 is an example of a highly variable lot of hay. Variability is primarily due to soil contamination, as seen by variable and excessive levels of ash, Al, Fe, and Ti. Soil contamination also caused a very high correlation of ash content with energy content (Fig. 3). A reasonable estimate of energy content of hays could probably be determined from ash values, avoiding expensive BTU analysis. Additional care may be required when baling mulch hay to be used as a combustion bioheat source.

Summary

A grass biomass combustion system could be economically feasible, environmentally desirable, energetically very efficient, and fit in very well with livestock farming operations. Mulch hay, however, is currently selling for up to $125/ton delivered. Mulch hay is also being used as a last resort forage source for ruminants, due to shortages of forage crops. Under current conditions it is not economically feasible to market mulch hay as a bioheat feedstock, the actual energy value of a ton of mulch hay is less than $50. Biomass combustion should be a very cost-effective practice to mitigate greenhouse gases.

Additional Resources

Cherney, J.H. and K.M. Paddock. 2013. Overwintering Switchgrass in the Field in NYS. Bioenergy Information Sheet #10. www.grassbioenergy.org.

Cherney, J.H., K.M. Paddock, and Q. Ketterings. 2013. Soil Contamination Issues with Grass Biomass. Bioenergy Information Sheet #15. www.grassbioenergy.org.

Cherney, J.H. and V.K. Verma. 2013. Grass Pellet Quality Index: A Tool to Evaluate Suitability of Grass Pellets for Small Scale Combustion Systems. Applied Energy 103:679-684.

Acknowledgments

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For more information

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