PRELIMINARY STUDY OF THE INFLUENCE OF 2,4-D ON THE DIGESTIBILITY OF ENSILED LAWN CLIPPINGS AND THE LEVEL OF ACCEPTANCE BY LAMBS

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Impact Statement

Grass lawn clippings were able to be successfully ensiled and were an acceptable form of forage for sheep. The addition of 2,4-D herbicide did not have a significant effect on digestibility, however some of the 2,4-D did pass through the digestive tract of the lambs and ended up in the fecal matter. Lawn clipping silage may be a promising forage feed source for the livestock industry.

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SUMMARY

Approximately 20% of all waste placed in landfills in the United States consists of grass clippings. While the acres in lawn production have been increasing, with an estimated 120,000 km^2 of lawns in 1987 and 163,801 km^2 in 2005, the number of landfills in the United States have been decreasing, from 7,683 in 1986 to 1,908 in 2009. The purpose of this study was to evaluate whether lawn clippings could be successfully used as livestock feed in order to redirect and productively utilize this large waste stream. Lawn clippings from a local golf course were evenly divided into a control and a treatment pile. Both piles were treated with 3 parts water and 1 part 99% acetic acid, with the treatment pile also being treated with 2,4-D and ensiled for five weeks. Eight Rambouillet lambs were fed the ensiled lawn clippings for 9 days, with 3 days of acclimation prior to sampling. Four lambs were fed the control silage and four lambs were fed the treated silage. Results from the study showed the lawn clippings could be successfully ensiled. The lambs readily accepted the lawn clipping silage as a feed, with only one lamb refusing to eat the silage for 24 hours at the start of the feeding trial and no silage refusal the remainder of the feeding period. There was no significant difference between digestible ADF, digestible NDF, digestible CP, and DM digestibility between the control and treated silage. The results demonstrate the silage is an acceptable feed source and the 2,4-D did not have an effect on silage digestibility.

INTRODUCTION

The rapidly declining agricultural land base and a continuously climbing world population have many experts searching for more efficient ways to produce enough food. As income increases, the demand for quality meat increases as well (Gerbens-Leenes, et al., 2010). The need to produce more meat is preceded by the need to have more land on which to grow the additional animal protein, or farmland to produce grain crops to feed animals in feedlot systems. In the United States alone, land in agriculture production has decreased by 73-million square miles from 1990 to 2012 (EPA, 2013). The estimated per capita poultry and red meat consumption within the United States as of 2015 is 208.5 pounds, up from 199 pounds in 1990 (USDA, 2015a,b). With the increase in population from 1990 to 2013 of 66.3-million, this is an increase of 4-billion pounds of total meat consumed since 1990 (USDA, 2015b).

In addition to the continual increase of meat consumption within the United States, the United States Department of Agriculture: Economic Research Service projects that developing countries around the world will constitute 81% of the global increase in meat consumption within the next eight years (Trostle and Seeley, 2013). It is unlikely there will be an increase in the amount of land available for agricultural production in the near future, making more efficient methods of producing food, especially meat, of great importance. In the pursuit of decreasing food waste and waste streams associated with the food system, waste streams that can be used in the production of food need be identified.

Residential lawn production is estimated to cover about 20-million square miles in the United States, compared to the estimated 56-million square miles in hay production, and 80-million square miles in corn production (EPA, 2013; USDA, 2014). Lawns, residential and recreational, are a relatively large sector of grass production in this country, accounting for 40.5-million square miles of land (Milesi et al., 2005). According to Wilson and Koski (2014) from Colorado State University, grass clippings make up 20% of the material sent into landfills each year within the United States. While the current amount of land already used to produce livestock feed is extensive, production on farmland is nearing the yield ceiling (de Bossoreille de Ribou et al., 2013). Additionally, the number of landfills countrywide is decreasing. In 1986 there were 7,683 landfills in the U.S., and by 2009 that number had fallen to just 1,908 landfills (Palmer, 2011; EPA, 2010). If lawn clippings can be used as a livestock feed, a portion of the waste stream yard debris creates could be redirected from going into landfills.

PROCEDURES

Two students from Montana State University recently conducted a preliminary study to determine whether the idea of using lawn debris as a livestock feed is feasible or not. For the study, the students collected grass clippings from Black Bull Golf Course in Bozeman, MT. The students split the grass clippings from the golf course into two piles, a control and a treatment pile. Both piles contained 232.75 pounds of grass clippings each and were treated with one liter of acetic acid and three gallons of water. The acetic acid was sprayed on the grass clippings to aid in the ensiling process and the water was added to bring the moisture content of clippings up to the desired amount of 66.5%. The treatment pile was also sprayed with 4 ounces of Spectracide Weed Stop. The active herbicides in Spectracide Weed Stop are 2,4-D, Mecoprop, and Dicamba, at concentrations of 7.59%, 3.66%, and 0.84% respectively. The 2,4-D was added to the treatment pile in order to determine whether feeding lawn clippings from lawns that have been treated with an herbicide would have an ill effect on the feed value of the silage and on the animals consuming the feed. Once both the control and the treatment piles were processed, the clippings were packed into individual 55-gallon steel barrels that were then sealed with airtight lids. The grass clippings were then left to ensile for five weeks.

After the grass clippings were ensiled, the silage was fed to eight lambs for nine days. Four of the lambs were fed the control silage, while the other four were fed the treated silage. The lambs were fed at 2% of individual body weight each day (NRC, 2007). The average weight of the lambs was 81 lbs. ± 6.2. The lambs fed the control silage received an average of 6.2 pounds (± 4.4) of silage per day and the lambs fed the treated silage received an average of 6.6 pounds (± 2.2) of silage per day. The lambs were fed half of their daily ration in the morning and the other half in the evening. During the study, each lamb was kept in an individual crate and had ad libitum access to water at all times.

RESULTS AND DISCUSSION

The results from this study show that lawn clippings can be successfully ensiled, the resulting silage is readily accepted by lambs, the feed value of the silage is comparable to commonly fed livestock feeds, and the herbicide content in the feces was less than the herbicide content in the silage.

The ensiling process was successful as determined by the final pH and DM content of the silage (BonSilage, Grass Silage

Handbook).The DM, NDF, and pH were within the ideal ranges for DM, pH, and NDF of 28-35%, 4.0-4.8, and 42-48, respectively. The final pH of the silage was 4.6 (± 0.17) and the final DM content of the silage was 40%. The DM content was slightly high for ideal grass silage but the pH level of the silage was within the desired range (BonSilage; Harrison et al., 1994).

Throughout the entirety of the feeding period, only one lamb refused to eat the silage, and that was only during the first 24-hours of the feeding trial. No silage refusal was collected the remainder of the sampling period.

The NDF content was higher than desired, with 60.4% and 61.9% for the control and treated silage, respectively (BonSilage). The CP levels were high in both silage groups, 18.7% and 18.3% CP for the control and treated, respectively. These CP levels are comparable to the CP levels in dairy quality alfalfa hay (Balliette and Torell, 2007). The overall digestibility of the silage was low with dNDF at 30.5% (± 4.9) and 27.6% (± 4.9), dADF at 16.5% (± 4.2) and 13.7% (± 3.4), and DMD at 41.6% (± 3.7) and 40.3% (± 3.7) for control and treatment silage, respectively. The NDF levels were thought to be high and the digestibility was thought to be low due to the maturity of the grass used for the study. It was found that the 2,4-D did not affect the digestibility, with no significant differences between the control and treated silage. In addition, numerical data showed less 2,4-D in the feces than in the silage, with 82mg/kg of 2,4-D in the treated grass (before ensiling), 110mg/kg in the treated silage, and 6.8 mg/kg in the combined fecal matter from the lambs fed the treated silage. To better understand where the herbicide residue ends up further studies will need to be conducted.

This preliminary study illustrates that lawn clippings may be a source of livestock feed. In future studies it will be necessary to feed the silage ad libitum and to offer the silage with another available feed source. However, based on a previous study by Przemyslaw S. et al. (2015), we expect the grass silage would still be readily desired. Additionally, the metabolic path of 2,4-D will need to be examined further by collecting urine, muscle, and adipose tissue samples in addition to fecal samples and analyzing the 2,4-D content of each.

Overall this study shows there is the possibility of redirecting the large waste stream lawn clippings creates to be a valuable source for livestock feed.

REFERENCES

Balliette, J., and Torell, R.. 2007. Alfalfa for beef cows. Fact scheet. Uni of Nevada Coopertive Extension. http://www.unce.unr.edu/publications/files/ag/other/fs9323.pdf#search="alfalfa%20for%20beef%20cows". Accessed: March 19, 2015.

BonSilage. Grass silage handbook: guide to successful grass ensiling. Schaumann. http://www.bonsilage.de/_pdf/FIBEL_BONSILAGE_grass_en.pdf. Feuchtwangen, Germany. Accessed: March 19, 2015.

Bormann, F. H., Balmori, D., and Geballe, G. T.. 1993. U.S. lawn care facts as annual totals and percentages. Redesigning the American lawn. http://www.epa.gov/greenacres/wildones/handbk/wo8.html. Accessed: November 4, 2014.

de Bossoreille de Ribou, S., Douam, F., Hamant, O., Frohlich, M. W., and Negrutiu, I.. 2013. Pland science and agricultural productivity: Why are we hitting the yield ceiling?. J. Plant Sci. 210: 159-176.

EPA. 2010. Municipal solid waste in the United States, 2009 facts and figures. http://www.epa.gov/waste/nonhaz/municipal/pubs/msw2009rpt.pdf. Accessed: March 3, 2015.

EPA. 2013. Land use overview. http://www.epa.gov/agriculture/ag101/landuse.html. Accessed: December 8, 2014.

Garabrant, D. D., and Philbert, M. A. 2002. Review of 2,4-dichlorophenoxyacetic acid (2,4-D) epidemiology and toxicology. Critical review in toxicology. 32(4):233-257.

http://eds.a.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=3893d359-c2d0-4dc5-a95c-a15779ebb81c%40sessionmgr4004&vid=2&hid=4202. Accessed: February 26, 2015.

Gerbens-Leenes, P. W., S. Nonhebel, and M. S. Krol. 2010. Food consumption patterns and economic growth. Increasing affluence and the use of natural resources. Appetite. 55:3:597-608.

Harrison, J. H., Blauwiekel, R., and Stokets, M. R. 1994. Fermentation and utilization of grass silage. J. Dairy Sci. 77(10):3209-3235. http://www.journalofdairyscience.org/article/S0022-0302(94)77264-7/pdf. Accessed: March 19, 2015.

Milesi, C., Running, S. W., Elvidge, C. D., Dietz, J. B., Tuttle, B. T., and Nemani, R. R.. 2005. Mapping and modeling the biogeochemical cycling of turf grasses in the United States. http://link.springer.com/article/10.1007/s00267-004-0316-2. Accessed: March 4, 2015.

NRC. 2007. Nutrient Requirements of Small Ruminants. Animal Nutrition Series. The National Academies Press. Washington DC.

USDA. 2013. USDA and EPA launch U.S. food waste challenge: calls on both public sector and private industry to reduce food waste. http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2013/06/0112.xml. Accessed: April 3, 2015.

USDA. 2014. Corn: Background. Economic Research Service. http://www.ers.usda.gov/topics/crops/corn/background.aspx. Accessed: Dec 4, 2014.

USDA. 2015a. Livestock, dairy, and poultry outlook: February 2015. http://ers.usda.gov/publications/ldpm-livestock,-dairy,-and-poultry-outlook/ldpm-248.aspx. Accessed: March 15, 2015.

USDA. 2015b. Livestock and meat domestic data. All supply and disappearance. http://ers.usda.gov/data-products/livestock-meat-domestic-data.aspx#26084. Accessed: March 15, 2015.

Palmer, B. 2011. Go West, Garbage Can!: Are we running out of room for our garbage? Slate. http://www.slate.com/articles/health_and_science/the_green_lantern/2011/02/go_west_garbage_can.html. Accessed: December 9, 2014.

Przemyslaw, S., Cezary, P., Stanislaw, M., Krzysztof, L., Brabara, P., Zofia, A., Maja, F., Katarzyna, Z., and Zabek, K.. 2015. The effect of nutritional and fermentational characteristics of grass and legume silages on feed intake, growth performance and blood indices of lambs. Small Ruminant Research. http://www.sciencedirect.com/science/article/pii/S0921448814003186. Accessed: March 23, 2015.

Trostle, R. and Seeley, R.. 2013. Developing countries dominate world demand for agricultural products. United States Department of Agriculture: Economic Research Service. http://www.ers.usda.gov/amber-waves/2013-august/developing-countries-dominate-world-demand-for-agricultural-products.aspx#.VIYCYkujJg0. Accessed: December 8, 2014.

Wilson, C. R., Koski, T.. 2014. Eliminate grass clipping collection. Colorado State University Extension. Available: http://www.ext.colostate.edu/pubs/garden/07007.pdf. Accessed: Dec 4, 2014.

Table 1. Nutrient content of the ensiled grass clippings

	DM (%)	CP (%)	NDF (%)	ADF (%)	TDN (%)	NEl (Mcal/lbs)	NEm (Mcal/lbs)	NEg (Mcal/lbs)	RFV (%)
Control silage	33.64	18.7	60.4	40.9	55.9	0.57	0.54	0.31	88
Treated silage	31.28	18.3	61.9	40.6	56.2	0.57	0.55	0.32	86