A proposal on

The Evaluation of Corn Silage Samples Impacted by Hurricane Irene
to

The Dairy Industry

by

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Evaluation of Corn Silage Samples Impacted by Hurricane Irene

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Introduction

Hurricane Irene caused severe damage to crops in the Northeastern part of the United States. This insult occurred approximately one month prior to harvest for corn silage, which is the predominant forage crop that is fed to lactating dairy cows. High winds and rain resulted in various degrees of lodging to corn plants. In some fields, lodging was so severe that harvesting was impossible. In other fields, lodging was only to a moderate extent and the crops were harvested but the health of the plants was in question because normal flow of nutrients between the roots and the plant was most likely compromised. Flooding from over flowing rivers also resulted in plants being submerged under water for various lengths of time. Plants under stress from flooding usually respond by reduced photosynthesis and are thus more prone to root, ear, and stalk rot (Nielsen, 2003, 2011). If submerged for more than 48 to 72 h, plant death can occur because of a lack of oxygen in the soil (Thomison, 1995; Yordanova and Popova, 2007). In many instances, the flooding that occurred due to Hurricane Irene was above the ears of corn. When floodwaters receded, high quantities of silt remained on the ears and lower stalks of the plants. Corn plants were so extremely silt laden in a field on one Vermont farm that the majority of the field was never harvested because of the silt on his harvester. A small amount of forage that was harvested at this farm was tested and contained 28% ash (normal content should be about 4.2%; Dairy One, 2011) and 7,242 ppm Fe (normal levels of Fe are about 200 ppm in corn silage). The same forage also contained 4,368 ppm Al. Levels of Mg, Mn, Cu and Zn were higher than normal. The high Fe content was likely a combination of the soil itself as well as a result of soil wearing on the chopping blades of the harvester. The high Al was a result of this compound being high in the region. Although a high percentage of the Fe in this sample was probably in the ferric form (Fe³⁺) form and insoluble, there would be potential for reduction to the ferrous form (Fe²⁺) by acidic conditions in silage (Hansen and Spears, 2009) and the abomasum of a cow leading to excessive amounts of available Fe (Beede, 2009). High levels of this Fe have been documented to interfere with normal Zn and Cu status in ruminants (Phillippo et al, 1987; Prabowo et al., 1988). High Fe has also been reported to depress DM digestion and reduce VFA production in batch cultures of ruminal fluid (Harrison et al., 1992). High Fe in feed (1992 ppm) was hypothesized to cause toxicity in cattle (Oruc et al., 2009). Excess concentrations of Fe and Al have decreased intake and gain in lambs (Rosa et al., 1982). High levels of Al fed to calves has been reported to decrease intake and BW gains by 17 and 47%, respectively (Crowe et al., 1990).

Flood-impacted corn plants could also alter ensuing silage fermentations because of the increased content of ash and floodwaters contained mixtures of over flowing rivers with farm and municipal wastes. High ash could add to the buffering capacity of the plant and make it more difficult for pH to drop quickly and to a level low enough to stop microbial
fermentation. In addition there was potential for microbial residues on the corn plants. Depending on the types of microorganisms present, there could have been effects on silage fermentation and (or) there could be direct threats to animal health (because of pathogenic organisms) during feed out (Driehuis and Oude Elferink, 2000).

After the hurricane, the FDA advised producers to avoid harvesting crops for animal feed that had the potential for contamination from sewage, heavy metals, pathogens, and industrial chemicals. However, allowances were made based on a farm-to-farm basis with recommendations for segregation and monitoring of contaminated feed. In addition to the possible contaminants listed above, there was concern over high ash and microbial laden plants causing abnormal silage fermentations that might compromise the nutritive value of the crops. For example, the high buffering capacity of alfalfa accompanied with high moisture content at ensiling increase the probability of a clostridial fermentation. Poor fermentations are also subject to high incidences of Listeria in silages. The potential for increased loads of mycotoxins in harvested plants was also a concern because of physical damage to the plants allowing for fungal growth (Teller et al., 2005).

**Objectives**

To date, we have not been able to identify published research on documenting and evaluating the effect of flood damaged corn on silage fermentation and its resulting nutritive value for ruminants. Thus, the objectives of this study will be to collect and analyze samples of flood-impacted corn silage in the Northeastern region of the US to

a) determine the degree of soil and heavy metal contamination

b) determine if the compromised crops ensiled normally by analyzing for normal fermentation profiles and volatile organic compounds

c) determine the occurrence and quantify concentrations of mycotoxins

d) qualitatively assess the degree of contamination from major microbial pathogens

e) to assess the nutritive value of impacted silage.

*It is anticipated that data obtained from this study will serve as valuable benchmarks that can be used for harvest and feeding recommendations in the future should such a disaster happen again. Data from this trial will be made public but identification of specific farms will be kept confidential. Partners from industry who contribute funding to the project will be recognized in all presentations and publications of the data.*
Materials and Methods

Extension and industry personnel will collaborate and identify farms whose corn silage was compromised due to lodging and/or flooding as a result of Hurricane Irene. Approximately 75 affected silages and 25 unaffected corn silages (serving as controls) that have been ensiling for a minimum of 60 days and not more than 180 days will be collected. If possible, control samples should be collected from farms submitting affected silages or from farms in the same region.

All samples will be sent to Cumberland Valley Analytical for the following analyses:

1) Standard wet chem: DM, CP, SP, ADF (ADFom*), ADL, NDF (NDFom*), starch, sugar, ash, Ca, P, Mg, Na, Fe, Mn, Zn, Cu

2) In vitro NDF-D (NDF-Dom*), 30 h

3) Yeast and molds

4) Silage fermentation analyses: Lactic acid, VFA, titratable acidity, CP equivalent from ammonia, and ammonia N as a percentage of total N

5) Heavy metals: aluminum, antimony, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, phosphorus, potassium, selenium, sodium, sulfur, thallium, zinc

6) Mycotoxin panel: Aflatoxin B1, B2, G1, G2, Deoxynivalenol, Zearalenone, 15 Acetyl-Don, 3 Acetyl-Don and T-2 Toxin

*analyses to be corrected for ash and presented on an organic matter (om) basis

Cumberland Valley Analytical will subsample each silage and send a representative sample to the University of Delaware for the following analyses:

1) Volatile organic compounds using a solid-phase microextraction (SPME) protocol (Figueiredo et al., 2007) or comparable technique.

2) Qualitative analysis for Escherichia coli O 157, Listeria spp., and Salmonella spp. using a lateral flow technique (Strategic Diagnostics Inc., Newark, DE)

All samples will need to clear submissions through the University of Delaware before being sent to Cumberland Valley.
REFERENCES


**Proposed Budget**

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Flooded Corn Sample Instruction Sheet

A study is being conducted to determine the feeding value of corn silage samples that were affected by Hurricane Irene. Only compromised samples (from flooded and/or lodged fields) are eligible for this study. The identification of farms will be kept anonymous.

We thank you in advance for these samples and your help!

The ID Form must be completed and submitted to the University of Delaware for approval before a sample is sent to Cumberland Valley Analytical. You will be given a sample number to include with the sample for submission to Cumberland Valley Analytical.

Sample collection and amount:
1. Silages should have ensiled for a minimum of 60 days and not longer than 180. Samples should not be frozen.
2. Avoid collecting your sample from the very first opening of a silo as these silages tend to have been exposed to air the most and are not usually representative of the whole silo. A representative sample from the morning feeding usually works best. The sample should be collected within a 2 hours of removal from the silo.
3. Collect a full quart-bag of wet sample (about 1 lb of material) and place it in a plastic bag (zip lock or cow sleeve, etc.). Remove as much of the air from the bag as possible by manually pressing the air out or using a food saver vacuum apparatus (if available). The sample should be kept cool (not frozen) prior to shipment. The best method to ship the sample is to have it surrounded by ice packs and in an insulated container. However, we realize this is not always feasible.
4. Samples should mailed via a next day delivery service (US Mail Express Service, UPS or Fed EX). Please check the delivery schedules as sometimes “Ground UPS Service” is sufficient to get a delivery to Cumberland Valley Analytical within a day. Prepaid UPS shipping labels are available from Cumberland Valley (contact them if you need one).

All samples will need to be approved for submission through the University of Delaware before being sent to Cumberland Valley.

Ship samples with approved ID number to:
Cumberland Valley Analytical
PO Box 669
Maugansville, MD  21767
Contact: Mr. Ralph Ward - Phone 301 790 1980; email: rward@foragelab.com
This sheet must be completed and sent to Jonathan Lim at the University of Delaware to obtain an ID number BEFORE a sample is sent to Cumberland Valley Analytical. Email to JONLIM@udel.edu 302 831 2269

Flooded Corn Sample ID Form

UD Sample Number: ____________

1. Name and contact info (phone/email) of person submitting the sample:

2. Farm owner or name and location (city/state, contact info - email/phone)

3. Date of ensiling: ____________ Silo type (e.g. bag, bunker, tower): ____________

Corn hybrid: _____________________

4. Date (or projected date) that this sample as collected: ____________

5. Was this sample damaged from the hurricane? Circle one-
   Yes (if yes continue with survey)
   No (if no, go to question G)

6. Was this silage segregated from undamaged silage? Circle one-
   Yes        No

7. Degree of crop damage – Answer all that apply

   A. Degree of flooding
      Circle a number
      1. Over the entire plant
      2. Over the ear
      3. More than a foot
      4. Less than a foot

   B. Degree of lodging
      Circle a number
      1. completely flattened
      2. 75% lodged
      3. 50% lodged
      4. 25% lodged
      5. no lodging
C. Plant condition at harvest

Circle a number
1. significant amount of silt
2. moderate amount of silt
3. general plant health appeared good
4. general plant health was poor (death, decaying, sprouting, moldy ears, etc. – describe below if needed)

D. Silage condition at feedout

Circle numbers as needed
1. Abnormal appearance (e.g., dark, off color, slimy, etc.)
2. Abnormal smell (describe if possible)

E. Has this sample been fed to animals?

Circle a number
1. Yes If yes, how long: ________________________________
2. No

F. If the answer above was “yes”, Please describe any abnormal issues related to feedout of the silage sample. (e.g., reduced intake, lower milk fat test, etc.)

G. What % of the ration dry matter is this silage being fed at?

8. Please circle the number (or numbers) that best describe the additive used on your crop:

   1. no additive used
   2. homolactic acid based microbial inoculant
   3. microbial inoculant with Lactobacillus buchneri
   4. propionic acid based additive ________ lbs/ton
   5. other: describe: ______________________

9. Other Comments

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