Impact of Different Nitrogen Fertilizers and Residue Management Schemes on Ammonia Volatilization from Sugarcane Production in Louisiana

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INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important row crops in Louisiana. It is a high biomass crop which requires large amount of nitrogen (N) supply throughout the growing season. In major parts of the world, solid urea has traditionally been used for sugarcane production but the application of liquid urea ammonium nitrate (UAN) is becoming popular in recent days.

Burning of combine-harvested residues is a common practice in sugarcane production, although an increasing trend of retaining the residues has been reported in Louisiana. It was hypothesized that the difference in residue management schemes can affect N fertilizer use efficiency and result in different potential of NH_3 volatilization. Besides nutrient loss, NH_3 emission affects air quality as it is an active precursor of different $PM_{2.5}$.

Residue retained

Residue burned

OBJECTIVES

The purpose of this study was to:

1. Evaluate the volatilization loss of ammonical N as impacted by two common sources of N fertilizers (urea and UAN) and different residue management (residue retained and residue burned) practices
2. Establish the relationship of rainfall and soil moisture with the NH_3 volatilization

MATERIALS AND METHODS

The field experiment of first stubble cane was established in a commerce silt loam soil at the LSU AgCenter St. Gabriel Research Station. Half of the field was prepared as harvest residue leftover (residue retained) and the other half was residue burned. Nitrogen was applied at 135 kg ha^{-1} in the form of urea and UAN. Urea was surface broadcasted followed with soil and UAN was injected into the soil directly. The field experiment followed a randomized complete block design (RCBD) with 4 replications for each treatment.

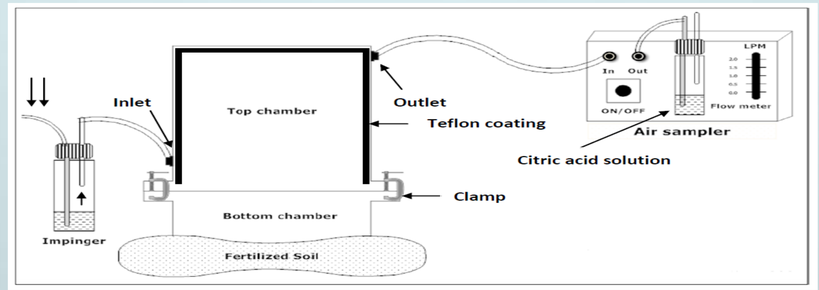
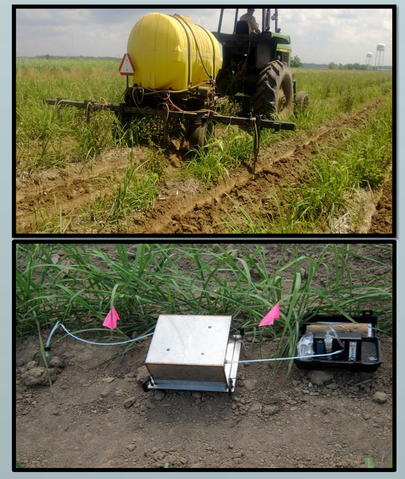


Figure 1: Working principle of active chamber system for NH_3 collection

Gaseous NH_3 was collected in a 4% citric acid solution using active chamber technique (Fig. 1). The collected samples were analyzed for NH_4^+ using an ion chromatography (IC).



RESULTS AND DISCUSSION

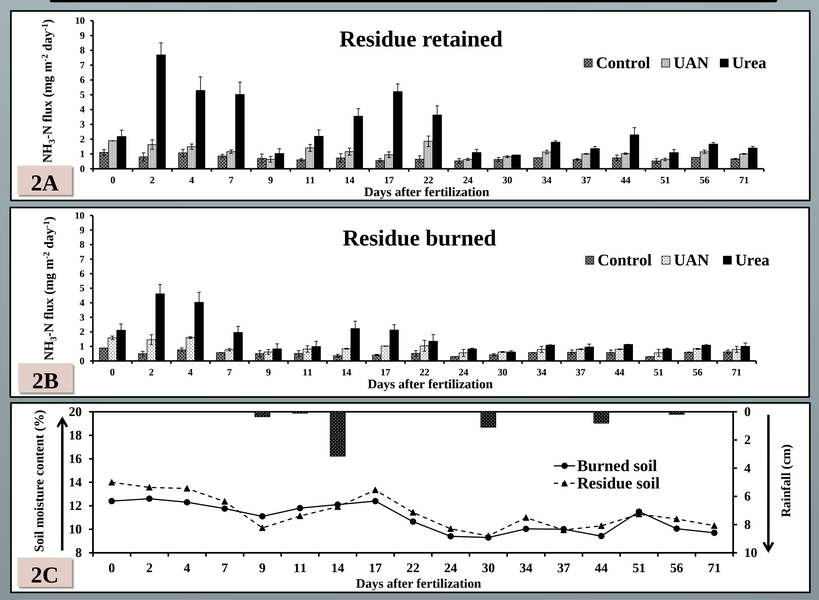


Figure 2: Ammonical N emissions from RR (fig 2A) and RB (fig 2B) plots; rainfall and soil moisture pattern for both the plots (fig 2C)

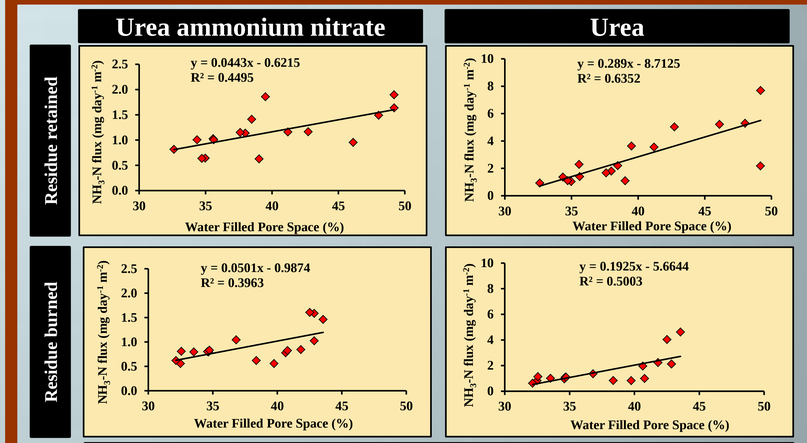


Figure 3: Relationship of water filled pore space (%) with NH_3-N flux for all treatments

Table 1: Effect of fertilizer and residue treatments on ammonia emission

Parameter	Residue retained	Residue burned
Urea	*	*
UAN	NS	NS

* Highly significant at α = 0.05; NS: Non significant

Volatilization of NH_3 was significantly higher in urea-treated plots ($p < 0.001$) than from UAN and control. Overall, urea had 55% higher NH_3 emission as compared to UAN.

Average NH_3 emission was 36% higher in residue-retained plots as compared to residue-burned plots. Greatest NH_3 losses were found within four weeks after fertilization.

Soil moisture showed significant impacts on NH_3 emission with higher correlation in residue-retained plots (Urea $r^2 = 0.64$; UAN $r^2 = 0.45$) as compared to the residue-burned plots (Urea $r^2 = 0.50$; UAN $r^2 = 0.40$).

Overall, the plots received combined treatment of residue-retained and urea, showed the maximum amount of NH_3 volatilization and the highest correlation with soil moisture.

ACKNOWLEDGEMENT

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