INTRODUCTION

- Poultry litter (PL), a mixture of excreta, bedding material and waste feed, is widely applied to grazing lands in Georgia, which is the top poultry producer in the US.
- Continuous application of PL improves soil fertility while it can lead to soil quality problems due to heavy metals added to poultry feed to control diseases.
- The rate limiting step of nitrification, which results in production of nitrate and nitrous oxide, is mediated by ammonia oxidizing bacteria (AOB) and archaia (AOA).
- The impact of repeated application of PL on soil ammonia oxidizers is not clear as previous studies have mainly focused on changes in nitrogen process rates.
- The combination of high ammonium and metal contents in PL might uniquely affect soil ammonia oxidizers as opposed to other animal wastes.

OBJECTIVE

- Examine changes in the function, abundance and community composition of ammonia oxidizers (AOA and AOB) after 15 years of PL application.

FIELD PLOTS AND METHODS

- Samples were collected from PL amended (F1, F2, F4 & F5) and control plots (F7 & F8) from two depths (5 and 15 cm) in 2009 & 2013 (Fig. 1).
- Samples in 2009 reflect 15 years of continuous PL application while samples in 2013 were collected after PL application had been discontinued for 2 years.
- PL rate of application was 10 Mg ha⁻¹ yr⁻¹. Control (CL) plots received equivalent amount of N in Urea Ammonium Nitrate.
- The soil slurry method was used to quantify nitrification potential, which was used as an indicator of the function of ammonia oxidizers.
- Denaturing Gradient Gel Electrophoresis (DGGE) and amoA-amoA Intergenic Spacer analysis (AISA) were used to fingerprint the soil AOA and AOB communities, respectively.
- Quantitative PCR was used to determine the copy numbers of amoA gene in AOB and AOA.
- Statistical and fingerprint analyses were done with SAS and Bionumerics software.

RESULTS

Table 1: Abundance of amoA gene in AOB and AOA in PL amended and CL plots

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Soil Depth (cm)</th>
<th>Treatment</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial amoA (log copies/ g soil)</td>
<td>0-5</td>
<td>10.5a</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>0-15</td>
<td>9.4a</td>
<td>8.8a</td>
</tr>
<tr>
<td>Archeial amoA (log copies/ g soil)</td>
<td>0-5</td>
<td>8.3a</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>0-15</td>
<td>8.4a</td>
<td>8.0a</td>
</tr>
<tr>
<td>Ratio of AOB to AOA</td>
<td>0-5</td>
<td>8.7</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>0-15</td>
<td>2.8</td>
<td>4.2</td>
</tr>
</tbody>
</table>

SUMMARY AND CONCLUSIONS

- Trace metal contents were higher in PL amended than CL plots in 2009, and did not decrease significantly after PL application was discontinued (Fig 2).
- Fifteen years of PL application increased the abundance of ammonia oxidizers as compared to CL plots, AOB being numerically dominant over AOA (Table 1).
- PL application resulted in increased nitrification potential in spite of increased metal concentrations (Table 2).
- Impact of PL application was more pronounced in the top 5 than 15 cm.
- AISA & DGGE profile analyses showed no significant difference in AOB and AOA composition between PL and CL plots (Table 2 & Fig. 3).
- AISA profiling of AOB indicated that majority were from Nitrosospira spp. in both types of plots (Fig. 3b), which is consistent with previous studies.
- In conclusion, the effect of repeated application of PL was in changing the abundance and function of soil ammonia oxidizers but not their composition.
- Increased metal concentrations as a result of repeated PL application did not seem to have negatively impacted the abundance, function or the community structure of ammonia oxidizers.

REFERENCE