Field and Laboratory Evaluation of Nitrogen Release from Poultry Litter

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Introduction

- Poultry is Alabama's number one agricultural industry generating 1.68 million tons of poultry litter (PL) year^{-1}.
- Due to its nitrogen (N) value and steady increases in fertilizer prices, interest in using PL as an alternative N source has renewed among row crop producers.
- However, unlike conventional fertilizers, N in PL is mainly present in organic forms.
- Plant N availability from PL is dependent on the rate of N mineralization i.e., conversion of organic N to inorganic N (NH_4-N + NO_3-N).
- Laboratory incubation studies are often used to estimate mineralizable N. However, they do not reflect true fields conditions.

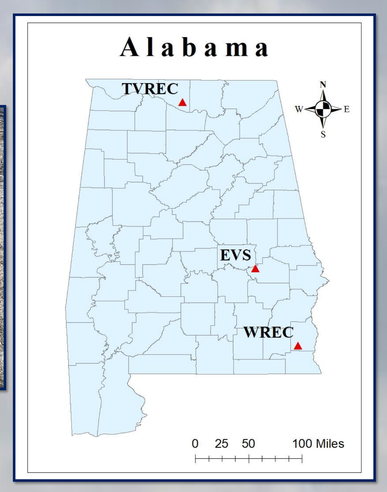
Objectives

- To determine the rate of mineralizable N from PL applied at three rates under field conditions.
- To study the N release pattern from PL using a 7-step sequential extraction with water.

Materials and Methods

Mesh Bag Technique

- Three different soil types and production environments:
  - Compass loamy sand at E.V. Smith Research Center (EVS) near Shorter, AL.
  - Dothan fine sandy loam at Wiregrass Research and Extension Center (WREC) near Headland, AL.
  - Decatur silty clay loam at Tennessee Valley Research and Extension Center (TVREC) near Belle Mina, AL.
- Treatments included PL application at 67, 168, and 336 kg total N ha^{-1} with three replications.



- Mesh bags were placed on the soil surface and collected after 20, 50, 70, and 90 days.
- The residual total N in the PL samples was determined by dry combustion method (*Nelson and Sommers, 1982*).
- The rate of N release was calculated from the differences in N contents between the incubation periods.

7-step Sequential Extraction

- 0.3 g of PL was shaken with 30ml of de-ionized water (1:100) for 1 hour followed by centrifugation at 4000 rpm for 20 minutes, and filtration through a 0.45µm filter (step one).
- A 30 ml volume of de-ionized water was added to the PL residue from step one. The extraction procedure was repeated as described above for a total of 7 times.
- Filtrate solutions from each step were measured for inorganic N by colorimetric method (*Keeney and Nelson, 1982*).

Figure 1: Color variations of the filtrates from the 7-step sequential extraction of poultry litter with de-ionized water.

Results and discussion

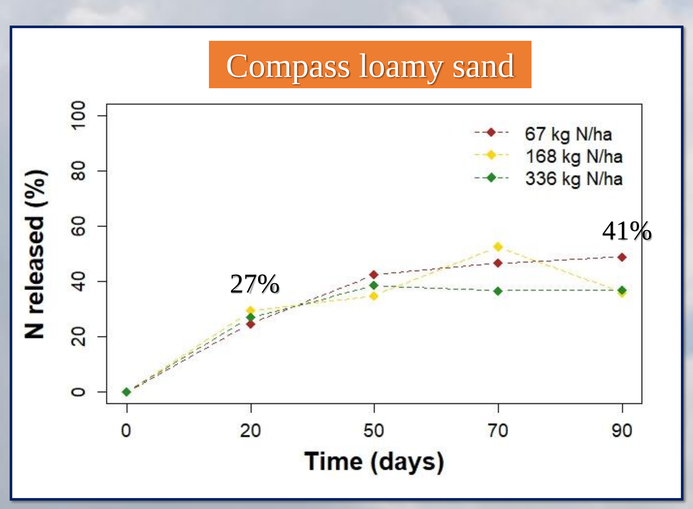


Figure 2: Nitrogen (N) released (%) from poultry litter applied at three N rates over 90-days of field incubation in a Compass loamy sand.

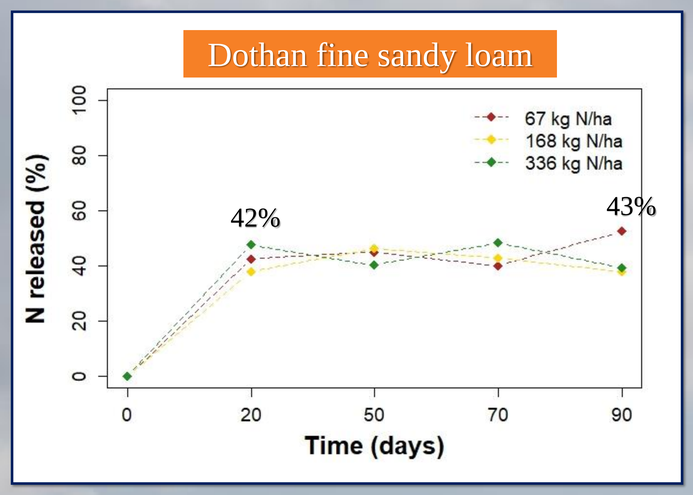


Figure 3: Nitrogen (N) released (%) from poultry litter applied at three N rates over 90-days of field incubation in a Dothan fine sandy loam.

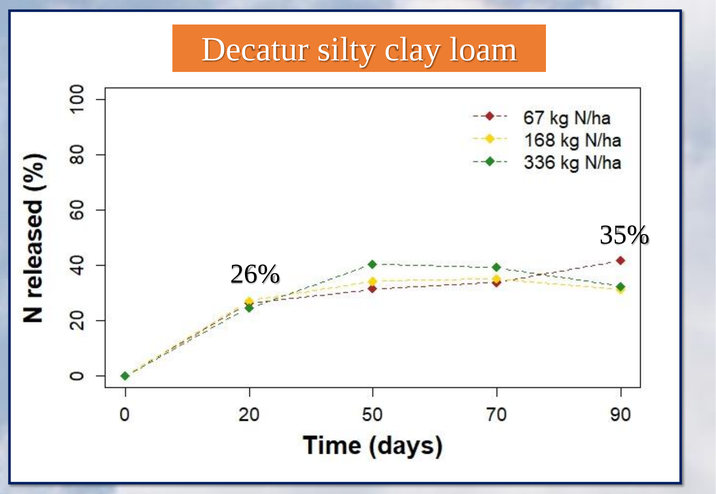


Figure 4: Nitrogen (N) released (%) from poultry litter applied at three N rates over 90-days of field incubation in a Decatur silty clay loam.

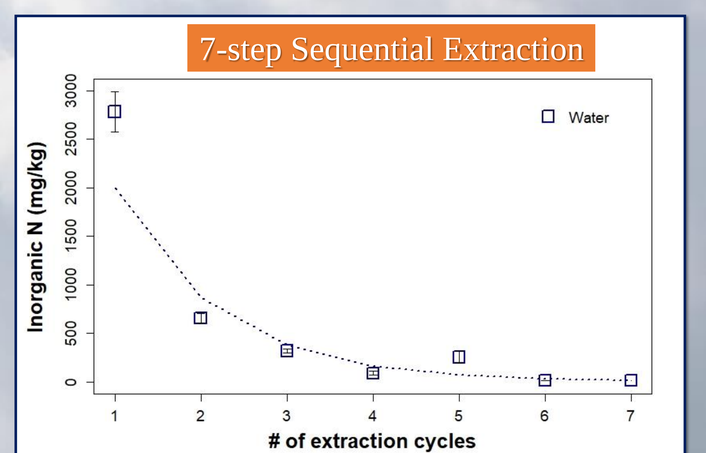


Figure 5: Inorganic N (NH_4 + NO_3) released (mg/kg) from poultry litter in the repeated extraction cycles using deionized water.

- Initial PL N content was 4% or 40,000 mg/kg.
- After 7 repeated extractions of PL with water, cumulative inorganic N released was 4134 mg/kg indicating release rate of 10%.
- Total N content in the PL decreased 35% (from 4% to 2.61%) after 7 repeated extractions.

Conclusion

- Under field conditions, the release rate of N from PL was highest (averaged 32%) in the first three weeks.
- After 90 days of field incubation, about 40% of the poultry N had been released to the soil.
- Up to 10% of litter N is water mineralizable.

References

- Nelson, D. W., and L.W. Sommers. 1982. Total carbon, organic carbon and organic matter. p. 539–557. *In* A. L. Page et al. (ed.) Methods of soil analysis. Part 2. 2nd ed. Agron. Monogr. 9. ASA, CSSA, and SSSA, Madison, WI.
- Keeney, D. R., and D.W. Nelson. 1982. Nitrogen-inorganic forms. In A. L. Page, et al. (Ed.), Methods of soil analysis. Part 2 (2nd ed., pp. 643–649). ASA, CSSA, and SSSA, Madison, WI.