# Nitrogen Release from Peanut Residue

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## Abstract

Residue management is an important aspect of crop production systems. Availability of plant residue nitrogen (N) to succeeding crops is dependent on N mineralization rates and therefore on rates of N release during decomposition. Much of the information available on N release rates from peanut (*Arachis hypogaea*) residue is based on controlled-environment studies. The objective of this study was to assess N release rates in the field from the residues of three peanut varieties (NC V-11, GA-02C and ANorden) at two depths (surface and 3.9 inches deep) and two locations (Upper Coastal Plain Experiment Station in Edgecombe County, North Carolina and Wiregrass Experiment Station in Henry County, Alabama), representing the northern and southern limits of commercial peanut production in the US. Litterbags containing the equivalent of 2.0 tons ac$^{-1}$ were placed in a completely randomized design at both locations, with four replications and retrieved periodically up to 335 days after application. Results show a statistical difference for depth by time (within location) interactions and fit single or double exponential decay models. Buried residues mineralized N at higher rates than surface residues in North Carolina during the initial 49 days of decomposition. The Virginia type cultivar NC V-11 released N at higher rates than the two runner types tested in North Carolina. After the initial rapid phase of decomposition, there was no difference in rates of N release at either experiment station. No treatment differences were found at the Wiregrass Experiment Station. The data suggest that N is released quickly after peanut harvest if residue is left in the field.

## Introduction

Residue management is an important aspect of crop production systems. Availability of plant residue N to succeeding crops is dependent on synchrony of N release and N uptake by succeeding crops and therefore on residue N mineralization rates (Bruulsema & Christie, 1987). Surface residue decomposition is important in conservation tillage systems and an increased understanding of N mineralization from surface residue may improve no-till residue management (Quemada and Cabrera, 1995). Much of the information available on N release rates from peanut residue is based on controlled-environment studies. Mubarak, et al., (2002) found that peanut haulm left on the soil surface released N at a rate of 0.201% week$^{-1}$ with no net immobilization over a period of 13 weeks in the humid tropics. However, field comparisons on N release rates from surface and incorporated peanut residue are lacking for the peanut growing region of the US.

The objective of our experiment was to assess N release rates of three peanut varieties at two locations under simulated no tillage and conventional tillage systems.

## Materials and Methods

A field decomposition study was set up at Wiregrass Research and Extension Center near Headland, AL (31º21'05"N, 85º20'10"W, 384 feet elevation) on a Dothan fine sandy loam 0-2% slope (Fine-loamy, kaolinitic, thermic Plinthic Kandiudults) and at the Upper Coastal Plain Experiment station near Rocky Mount, NC (35º56'07"N, 77º46'31"W, 111 feet elevation) on a Norfolk loamy sand, 2-6% slope (Fine-loamy, kaolinitic, thermic Typic Kandiudults). Three peanut varieties, Anorden, NC V-11 and GA 02-C, were grown at each research site to supply residue. Nylon mesh bags measuring 7.87 by 3.94 inches were used to determine biomass breakdown and N release patterns of

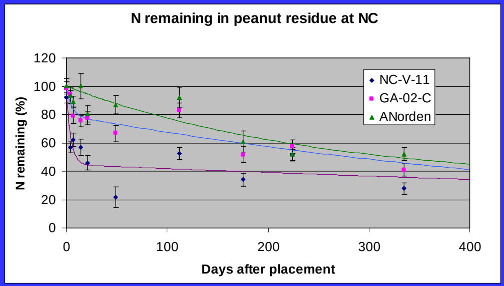


**Figure 1. Percent of original N remaining in three cultivars of peanut residue in North Carolina. Error bars represent standard errors. 100% represents 50 lbs N ac$^{-1}$.**

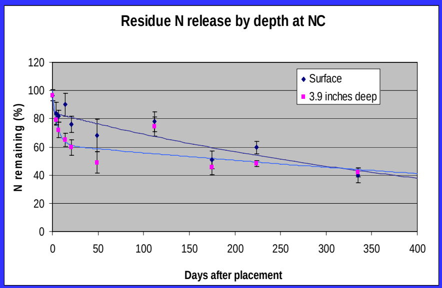


**Figure 2. Percent of original N remaining in peanut residue at two depths in North Carolina. Error bars represent standard errors. 100% represents 50 lbs N ac$^{-1}$.**

| N release from Peanut Residue at Rocky Mount, NC | |
|---|---|
| **Treatment** | **N release rate** |
| NC V-11[a] | $\%N=44.7+55.3e^{-0.23(days)}$ |
| Anorden[b] | $\%N=30.8+69.2e^{-0.00395(days)}$ |
| GA-02C[b] | $\%N=20.4e^{-0.199(days)}+79.6e^{-0.00165(days)}$ |
| Incorporated[y] | $\%N=38.4e^{-0.183(days)}+61.6e^{-0.00101(days)}$ |
| Surface placed[z] | $\%N=15.7e^{-1.48(days)}+84.3e^{-0.00200(days)}$ |

**Table 1. Treatments followed by the same letter are not significantly different at $p$=0.05.**

peanut residues in the field. Residue was collected after harvest and packed into the nylon mesh bags at a rate representing 2.0 tons ac$^{-1}$.

Litterbags containing each peanut variety were placed on the soil surface and buried at 3.9 inches deep. The treatments were arranged in a completely randomized design with 4 replicates at each location. Litterbags were retrieved from each location at approximately 0, 4, 8, 15, 29, 59, 114, 175, 225 and 335 days after application. The contents of each bag were weighed and dry matter determined. They were then ground to pass a 16 mesh sieve and analyzed for total C and N by dry combustion. Sample contamination by soil was accounted for by converting all data to an ash-free basis.

Statistical significance of treatments was determined using Proc Mixed (SAS Institute, 2003) at the 95% confidence level (CL). Within-treatment differences were analyzed using Tukey's studentized range test within Proc GLM at the 95% CL. Least squares estimates for nonlinear models were determined using Proc Nlin with Gauss-Newton methodology.

## Results and Discussion

The Virginia type variety NC V-11 mineralized N at a higher rate than the two runner type varieties at Rocky Mount, NC (Fig. 1). N release rates at NC are displayed in Table 1. Although there was no difference between initial C:N ratios among any of the varieties, the faster rate of N mineralization exhibited by NC V-11 may be due to its higher [(C:N)(%lignin)](carbohydrate$^{-0.5}$) value compared to the other two varieties (Herman et al, 1977). Preliminary data support this hypothesis.

N from peanut residue buried at 3.9 inches was mineralized faster than residue placed on the surface in NC (Fig. 2). It is likely that greater microbial activity at 3.9 inches below the soil surface is responsible for this result.

No statistical differences were found at Headland, AL for any of the treatments, though rates of N mineralization were generally higher than those at NC. Warmer and moister climatic conditions in AL are likely responsible for the lack of treatment differences at this location since the difference in microbial activity acting on residue at zero and 3.9 inches is likely to be less pronounced than those at NC.

## Conclusions

- In Rocky Mount, NC, N was mineralized from incorporated peanut residue more quickly than surface-placed residue.
- N was released from peanut residue at the same rate regardless of variety or depth at Headland, AL.
- Rates of N mineralization were generally higher in AL compared to those at NC.

## References

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