MICHIGAN STATE UNIVERSITY

Quantifying Nitrogen Mineralization from Weed Residue

MSU Weed Science

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Introduction

Many growers use a postemergence herbicide application to control weeds. Michigan State recommends controlling weeds in corn prior to the V4 growth stage to avoid grain yield reductions. These weeds need to be removed to reduce competition for space, light, water and nutrients. However, weeds can assimilate large quantities of nitrogen (N) prior to the V4. growth stage.

What happens to N assimilated by weeds after weed control?

Objectives

1. Measure the carbon:N (C:N) ratio of weed residue.
2. Quantify and determine rate of N mineralization from weed residue.

Materials and Methods

Field methods

- A field study was conducted in 2011 in East Lansing, MI.
- A split-plot, randomized complete block design was used with three replications. Study factors consisted of:
  - Nitrogen application rate (0, 67, 134, and 202 kg N ha^{-1})
  - Weed species [common lambsquarters (CHEAL), common ragweed (AMBEL), and giant foxtail (SETFA)]
  - Weed height (10 and 20 cm tall)
- Weeds were collected at either 10 or 20 cm. Fresh and dry weights recorded. Total N and C content were measured.

Laboratory incubation methods

- Soil collected from field study where 67 kg N ha^{-1} was applied. Moist field soil was homogenized and sieved.
- 20 g dry weight equivalent moist soil was placed into specimen cups. Ground weed residue was mixed with soil at 60 ppm N. There was a control specimen cup with no weed residue added. Specimen cups were stored in the dark at 25°C.
- Specimen cups were incubated for 6 time intervals (0, 1, 2, 4, 8, and 12 wk). At each incubation time, soil was destructively measured for nitrate-N (NO_3-N) and ammonium-N (NH_4-N).
- There were two runs of the laboratory incubations experiment.

Nitrogen mineralization determination

- N mineralization was considered to be the sum of NO_3-N and NH_4-N. NO_3-N and NH_4-N from control was subtracted to account for N mineralization from soil organic matter.
- Treatment effects were examined using the MIXED procedure in SAS. N release was fit to a first-order model using the non-linear regression procedure (NLIN), according to the equation:

$$N_{rel} = N_0 [\exp(-k_0 t)]$$

where, N_{rel} is N released, N_0 is potentially mineralizable N, k_0 is the first-order rate constant, and t is the incubation time.

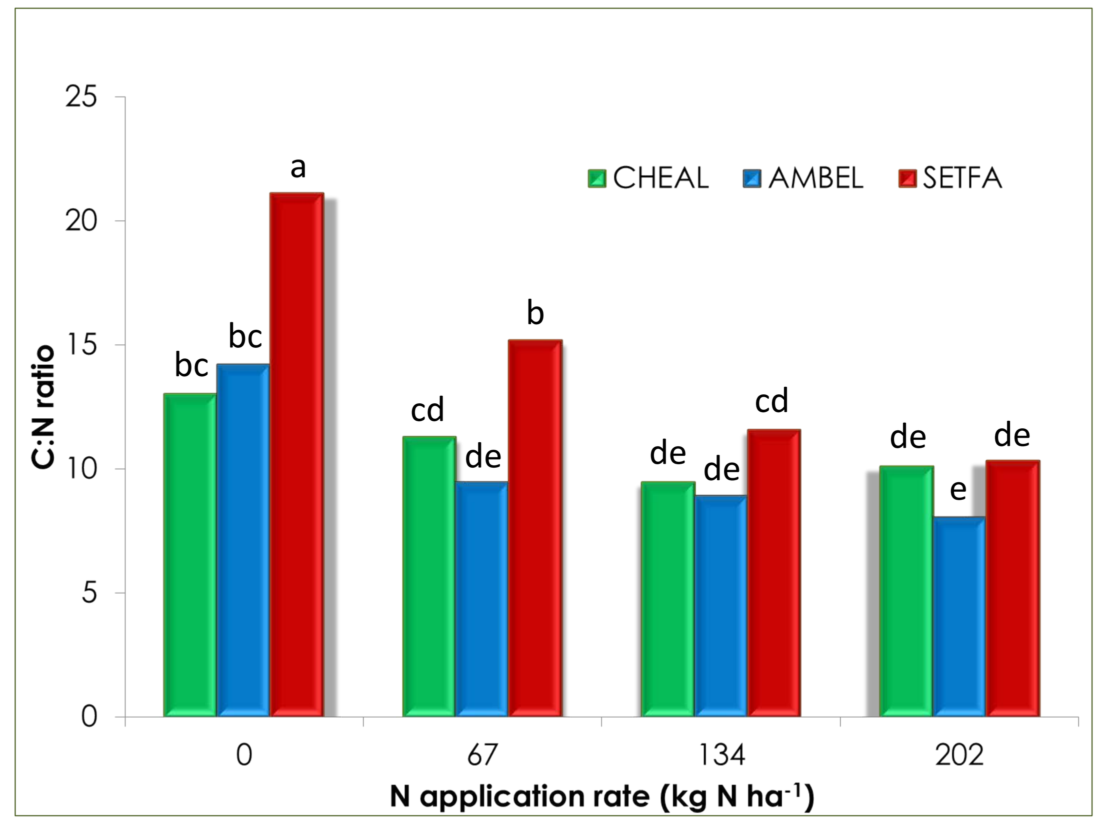

Figure 1. C:N ratio of weed species by N application rate.

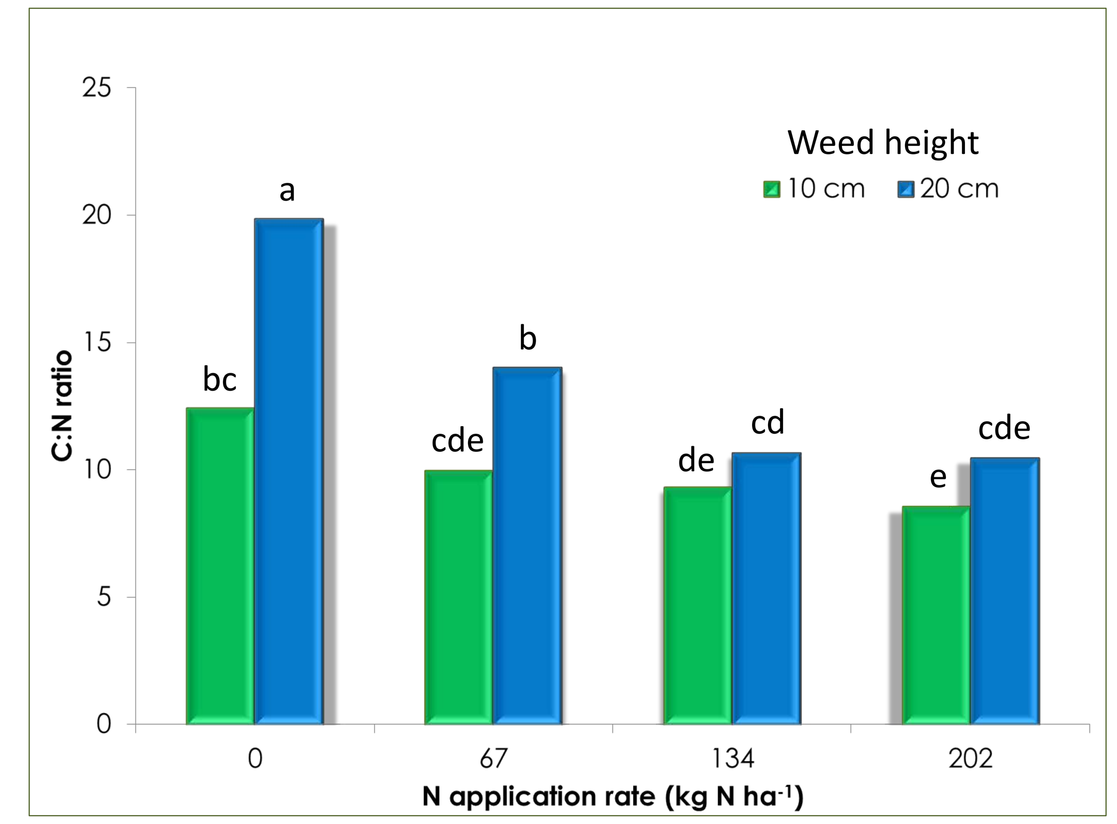

Figure 2. C:N ratio by weed height and N application rate.

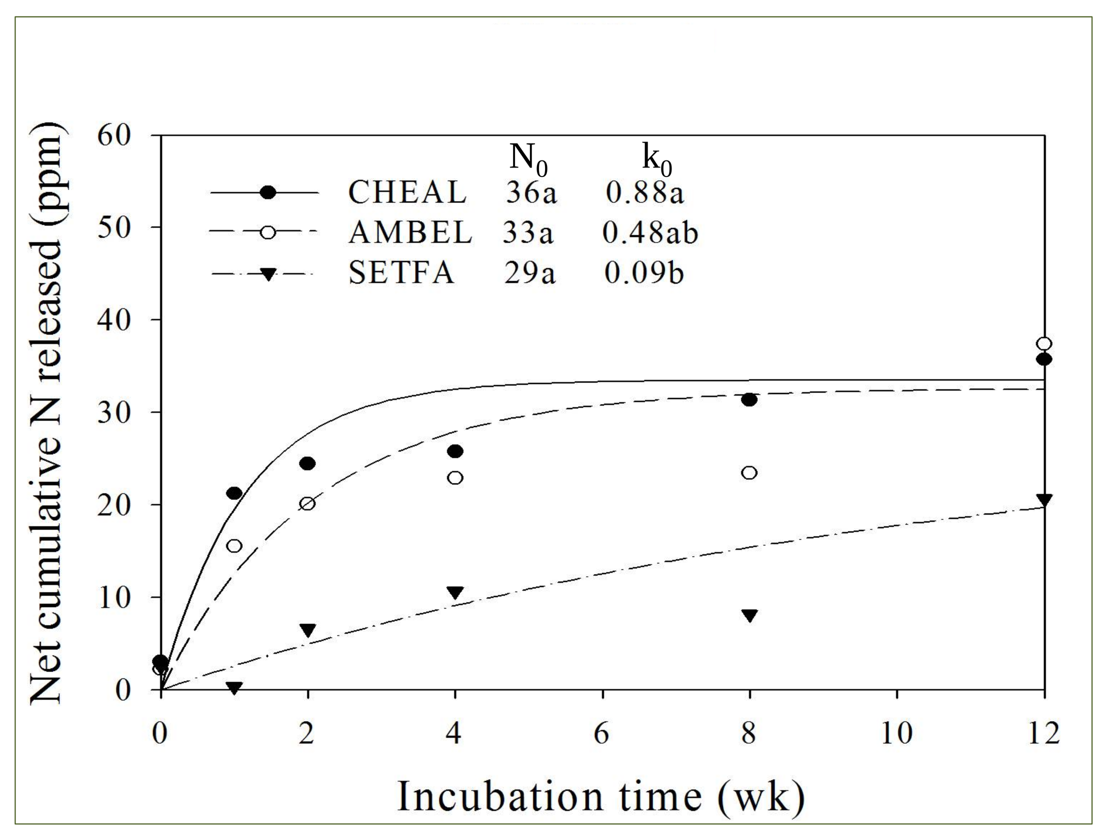

Figure 3. Net cumulative N release for 10 cm tall weeds grown at 0 kg N ha^{-1}.

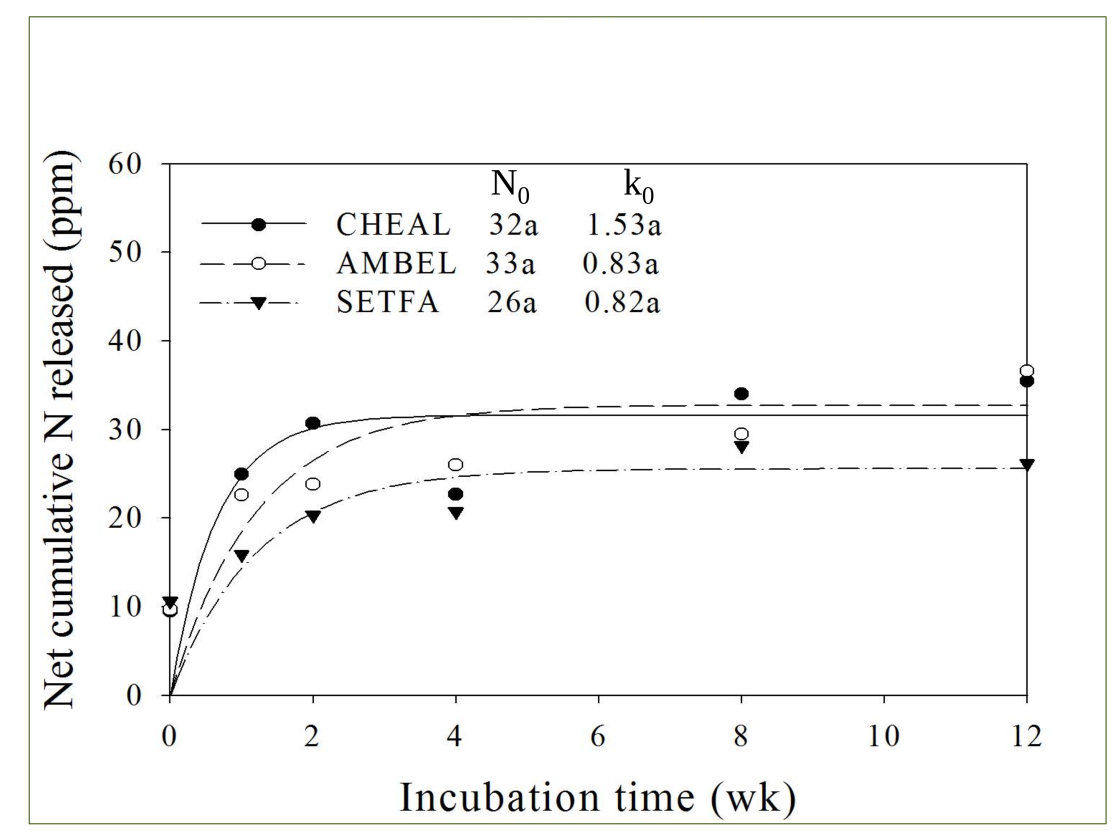

Figure 4. Net cumulative N release for 10 cm tall weeds grown at 202 kg N ha^{-1}.

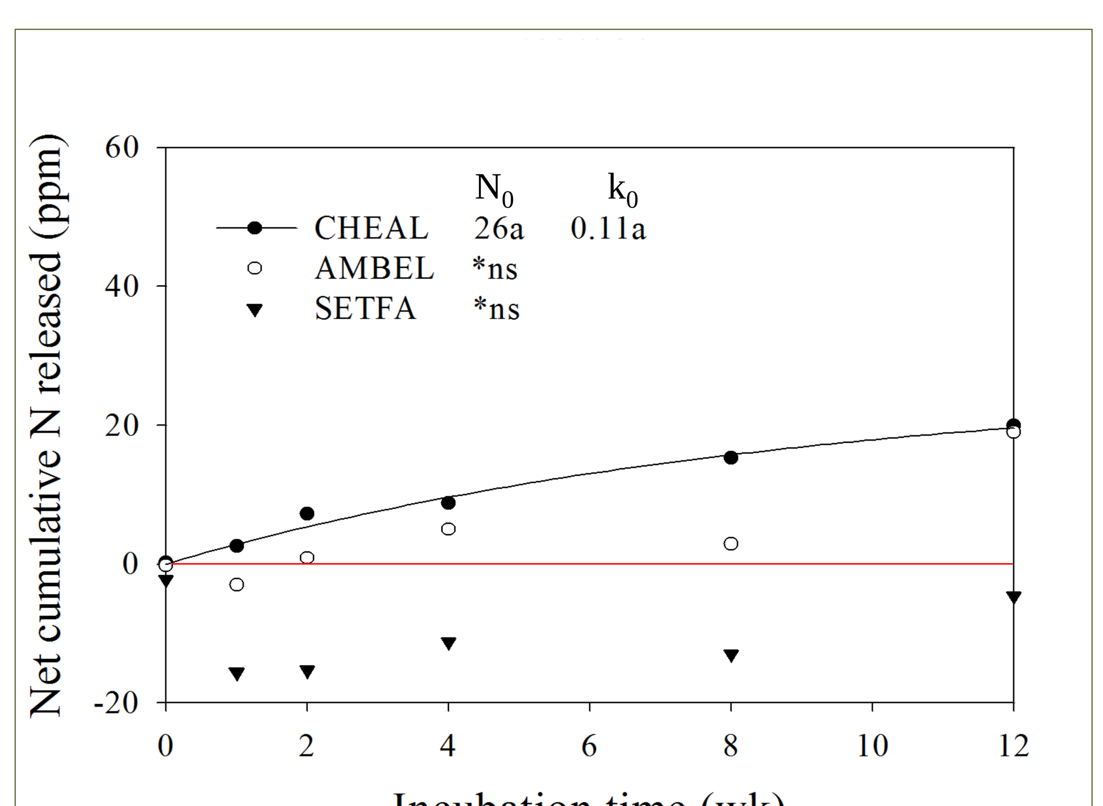

Figure 5. Net cumulative N release for weeds 20 cm tall weeds grown at 0 kg N ha^{-1}.

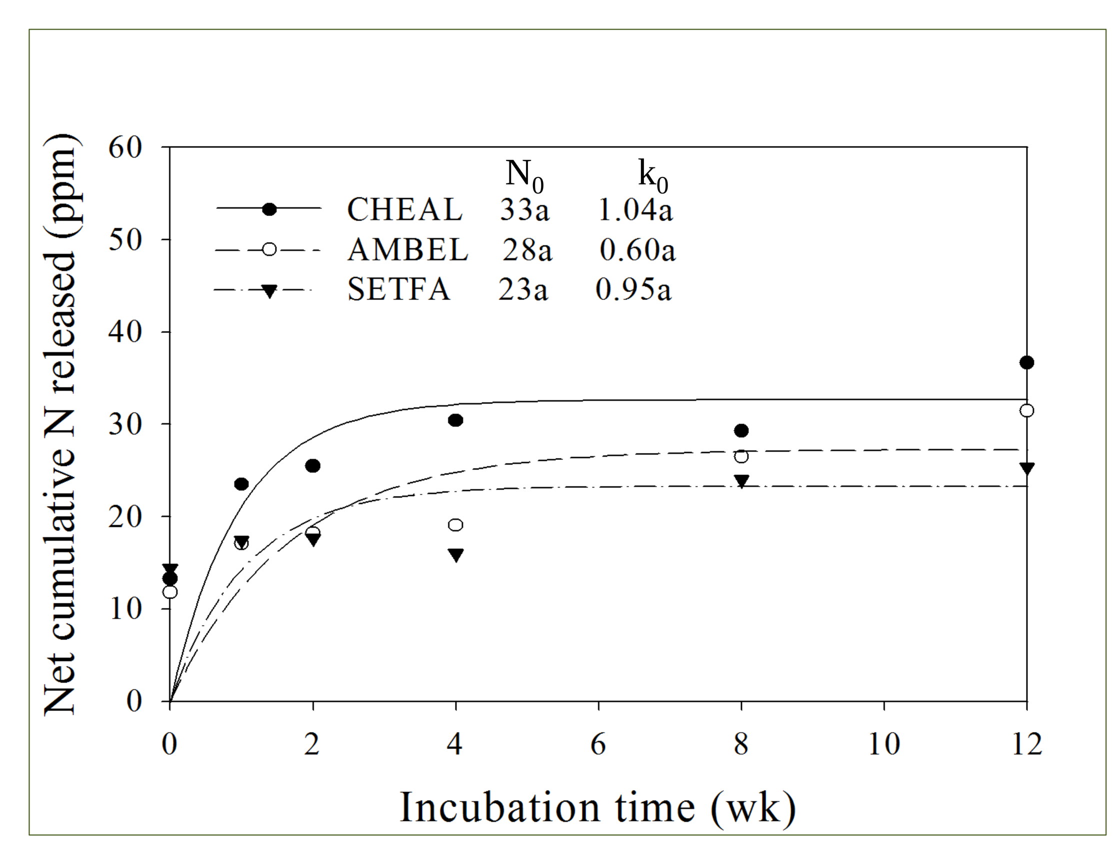

Figure 6. Net cumulative N release for 20 cm tall weeds grown at 202 kg N ha^{-1}.

Results and discussion

C:N Ratio

- Giant foxtail had a greater C:N ratio than common lambsquarters and common ragweed (Fig. 1).
- The C:N ratio of 20 cm tall weeds was greater than 10 cm tall weeds (Fig. 2).
- The C:N ratio of weeds decreased with increasing N application rate (Fig. 1 and 2).

Nitrogen mineralization

- When 10 cm tall weeds were grown at 0 kg N ha^{-1}, the mineralization first-order rate constant (k_0) was smallest for giant foxtail (Fig. 3). By 12 wk of incubation, ~50% of the total N in common lambsquarters and common ragweed residue was released and ~20% of the total N in giant foxtail was released.
- k_0 was greater for 10 cm tall weeds grown at 202 kg N ha^{-1} than 10 cm tall weeds grown at 0 kg N ha^{-1} (Fig. 3 and 4).
- When 10 cm weeds were grown at 202 kg N ha^{-1}, there was no significant difference in k_0 among the weed species (Fig. 4). By 12 wk of incubation, ~50% of the total N in common lambsquarters and common ragweed residue was released and ~40% of the total N in giant foxtail was released.
- When 20 cm tall weeds were grown at 0 kg N ha^{-1}, the N release model did not fit for common ragweed and giant foxtail (Fig. 5). By 12 wk of incubation, ~30% of the total N in common lambsquarters residue and ~0% of the total N in common ragweed was released. N was immobilized by giant foxtail.
- When 20 cm weeds were grown at 202 kg N ha^{-1}, k_0 was similar to that of 10 cm weeds grown at 202 kg N ha^{-1} and greater than weeds grown at 0 kg N ha^{-1} (Fig. 3-6).
- By 12 wk of incubation, ~50% of the total N in common lambsquarters, and ~25% of the total N in common ragweed and giant foxtail residue was released (Fig. 6).

Conclusions

- Weeds with C:N ratio of ~20 (i.e., 20 cm tall giant foxtail grown at 0 kg N ha^{-1}) may immobilize N.
- Smaller weeds and weeds grown at 67 to 202 kg N ha^{-1} (C:N ratios of 5 to 15) may mineralize ~40-50% N in 12 wks.
- Timely weed control is necessary to reduce N immobilization by weeds.