Nitrogen Consumption in Weed Species as Influenced by Application Rate and Weed Removal Timing

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INTRODUCTION

Nitrogen Management

- Nitrogen is often the most limiting nutrient in corn production.
- Nitrogen use efficiency needs to be optimized due to:
  - -Increasing environmental concerns surrounding surface and groundwater pollution.
  - -Recent increases in fertilizer costs.
  - -New nitrogen recommendations based on economic optimum N rate may be lower than in past.

Weed Control

- Michigan State recommends weed control prior to 10 cm weed height to avoid yield reduction (Dalley et al. 2003).
- At higher N rates, the critical time of weed control may increase (Evans et al. 2003)
- Previous studies indicate response to N supply is species dependent (Blackshaw et al. 2003; Harbur and Owen 2004), which may be due to differences in photosynthetic pathways (Brown 1985).

OBJECTIVES

- To measure nitrogen assimilation by giant foxtail, Powell amaranth, velvetleaf, common ragweed, and common lambsquarters
- To evaluate the effect of nitrogen rate and weed removal timing corn grain yield.

METHODS

- A study was conducted in 2009 at MSU Agronomy Farm in East Lansing.
- A split plot, randomized complete block design was used.
  - Main plot: N rate (0, 67, 134, and 202 kg N ha^{-1}).
  - Subplot: Weed control timing defined by weed height (0, 5, 10, 15, 20 cm, and weedy). Plots were maintained weed free after each removal timing.
- Weed biomass collected from 0.25 m^2 quadrats at each weed removal timing. Fresh and dry weights recorded.
- Giant foxtail, Powell amaranth, velvetleaf, common ragweed, and common lambsquarters were collected at each weed removal timing. Samples were dried, ground, and analyzed for total N using an elemental combustion system.
- Grain yield at 15% moisture was determined at harvest.
- PROC GLM and Fisher's Protected LSD in SAS used to determine significance and separate means.

Table 1. N removed by weeds at the 134 kg N ha^{-1} application rate

Weed Height (cm)	giant foxtail	Powell amaranth	common ragweed	common lambsquarters	total
	Nitrogen Removed (kg N ha^{-1})				
5	4	0.3	0.3	6	10.6
10	17	3	3	34	57
15	20	16	15	55	96
20	38	31	55	17	93

Figure 1. Shoot total N of giant foxtail by N rate and weed height.

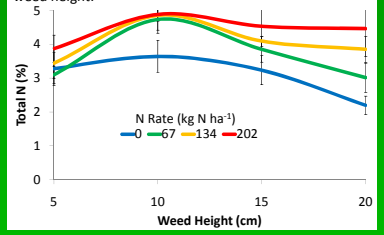

Figure 2. Shoot total N of Powell amaranth by N rate and weed height.

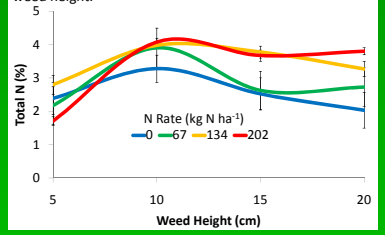

Figure 3. Shoot total N of velvetleaf by N rate and weed height.

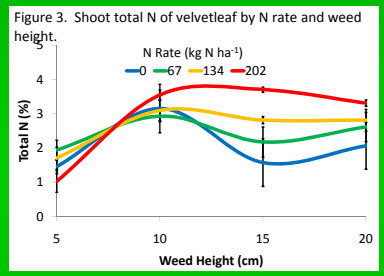

Figure 4. Shoot total N of common ragweed by N rate and weed height.

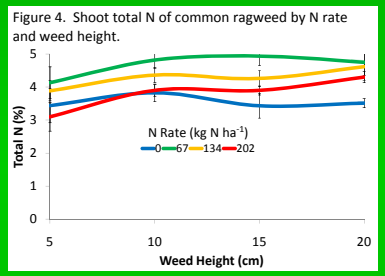

Figure 5. Grain yield by N rate and weed height at removal.

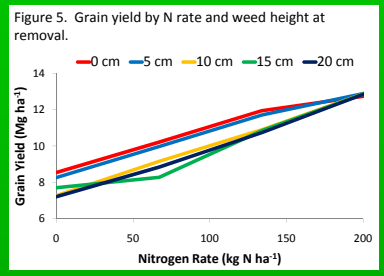

Figure 6. Economic return per hectare by nitrogen rate and weed height at removal.

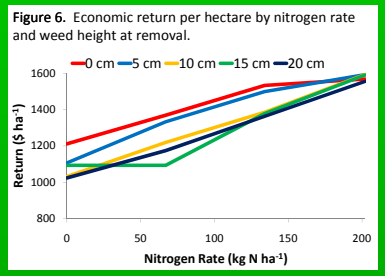

Figure 7. Common ragweed roots by weed shoot height at the 0 kg N ha^{-1} rate.

Figure 8. Common ragweed roots by nitrogen rate at 15 cm shoot height.

RESULTS AND DISCUSSION

Nitrogen Assimilation by Weeds

- Giant foxtail: Total N content increased with N application rate. Nitrogen uptake increased from 5-10 cm weed height at all N application rates except for 0 kg N ha^{-1} (Figure 1).
- Powell amaranth: Total N content was greatest when 134 and 202 kg N ha^{-1} was applied. Nitrogen uptake increased from 5-10 cm weed height at all N application rates (Figure 2).
- Velvetleaf: Total N content increased with N application rate. Nitrogen uptake increased from 5-10 cm weed height at all N application rates (Figure 3).
- Common ragweed: Total N content was only significantly different between the 0 kg N ha^{-1} rate and 67, 134, and 202 kg N ha^{-1} application rates. Only a slight increase in N content between 5-10 cm weed height (Figure 4).
- Common lambsquarters: No significant difference in total N content by N rate, but there was an increase in N content between 5-10 cm weed height (data not shown).

Nitrogen Removed by Weeds

- When 134 kg N ha^{-1} was applied, there was an increase in N assimilation by weed species on a hectare basis from 5-15 cm shoot height (Table 1).

Corn Grain Yield

- Grain yield was greatest when weeds were controlled 0-5 cm, except for when 202 kg N ha^{-1} was applied (Figure 5). At 202 kg N ha^{-1}, grain yield was the same among weed removal timings, indicating that grain yield loss due to delayed weed removal can be reduced with N applications.
- The greatest yield was achieved when 202 kg N ha^{-1} was applied.

Economic Return

- Economic return was greatest when weeds were removed by 0 cm, except for when 202 kg N ha^{-1} was applied (Figure 6). The largest economic loss due to the presence of weeds occurred between the 5 and 10 cm height removal timing.
- Economic return increased with nitrogen application rate.

CONCLUSIONS

- Nitrogen assimilation differed among weed species; however, it generally increased with N application rate and from 5-10 cm shoot height.
- Grain yield and economic return decreased when weed removal timing was delayed to 10 cm, except for at the highest N rate.
- Nitrogen use efficiency of corn decreased as weed removal timing increased.

FUTURE STUDIES

- Field study examining effect of sidedress N application rate on late-emerging weeds.
- Greenhouse study examining effect of N application rate and weed density on nitrogen assimilation of several weed species.

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