Nitrogen Partitioning in Weeds and Corn in Response to Nitrogen 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 the past

Weed Control

- Michigan State recommends weed control prior to 10 cm weed height to avoid yield reduction (Dalley et al. 2003)
- Critical weed free period may be delayed at higher N rates (Evans et al. 2003)
- Response to N supply is species dependent (Blackshaw et al. 2003; Harbur and Owen 2004)
  - May be due to differences in photosynthetic pathways (Brown 1985)
- Partitioning of nutrients may impact the competitive ability of weed species

Objectives

- To evaluate the effect of plant height on nitrogen and biomass partitioning between shoots and roots
- To evaluate nitrogen partitioning of velvetleaf (*Abutilon theophrasti*), common ragweed (*Ambrosia artemisiifolia*), giant foxtail (*Setaria faberi*), common lambsquarters (*Chenopodium album*) and corn (*Zea mays*) within nitrogen rate

Materials and Methods

- A study was conducted in 2010 at the MSU Agronomy Farm in East Lansing
- Four weed species were examined
  - Velvetleaf (ABUTH)
  - Common ragweed (AMBEL)
  - Giant foxtail (SETFA)
  - Common lambsquarters (CHEAL)
- Corn (ZEAMX) was also examined
  - Pioneer variety '37Y14'
  - Planted May 5
- Plants were removed based on weed canopy height:

Weed Canopy Height	Corn Growth Stage	Date
5 cm	V3	June 1
10 cm	V4	June 8
15 cm	V5	June 11
20 cm	V6	June 14

- Once removed, plants were counted, separated into shoot and root portions, and weighed
- Samples were analyzed for percent total nitrogen using the Dumas (1831) method
- Nitrogen partitioning is expressed by shoot to root ratios (S:R)
  - Calculated by dividing shoot value for nitrogen content or biomass by the respective root value
- Four nitrogen rates were examined
  - 0 kg N ha^{-1}
  - 67 kg N ha^{-1}
  - 134 kg N ha^{-1}
  - 202 kg N ha^{-1}

Statistics

A randomized complete block design was used with four replicates per treatment. Data was analyzed using SAS with PROC GLM and Fischer's Protected LSD ($\alpha = 0.05$).

Figure 1. Shoot to Root Nitrogen Ratio at 0 kg N ha^{-1} Rate

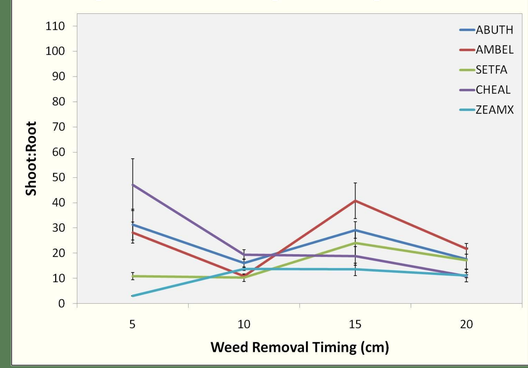


Figure 2. Shoot to Root Biomass Ratio at 0 kg N ha^{-1} Rate

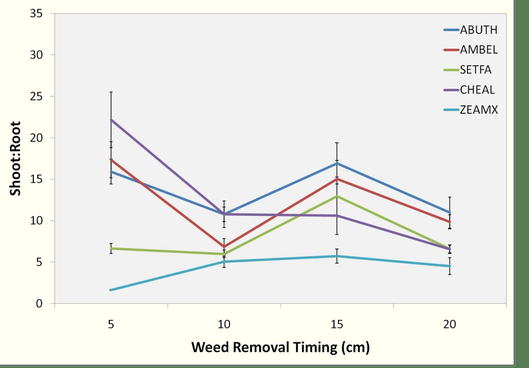


Figure 3. Shoot to Root Nitrogen Ratio at 67 kg N ha^{-1} Rate

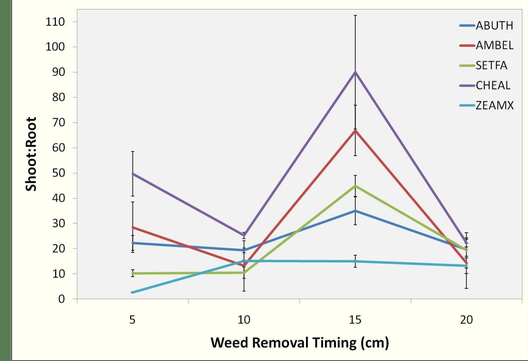


Figure 4. Shoot to Root Biomass Ratio at 67 kg N ha^{-1} Rate

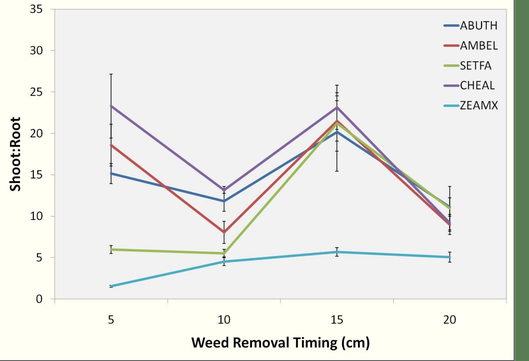


Figure 5. Shoot to Root Nitrogen Ratio at 134 kg N ha^{-1} Rate

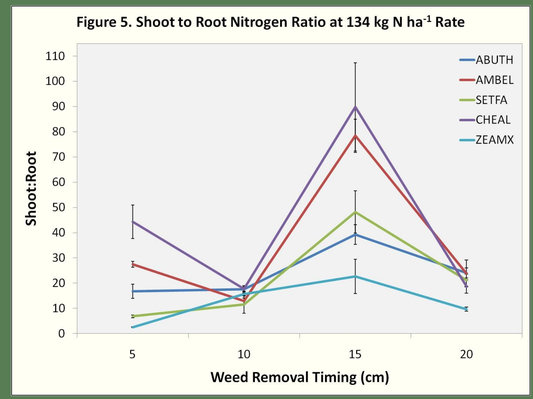


Figure 6. Shoot to Root Biomass Ratio at 134 kg N ha^{-1} Rate

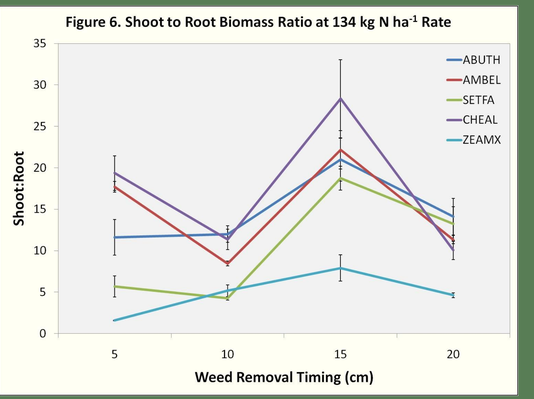


Figure 7. Shoot to Root Nitrogen Ratio at 202 kg N ha^{-1} Rate

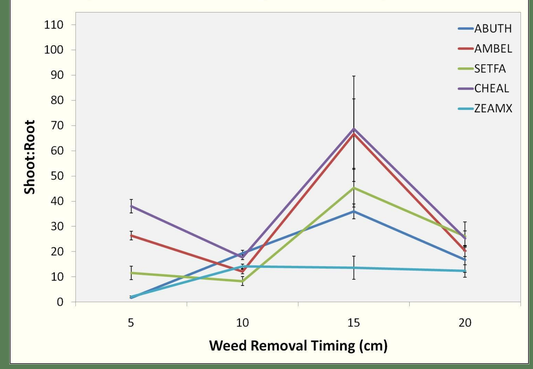
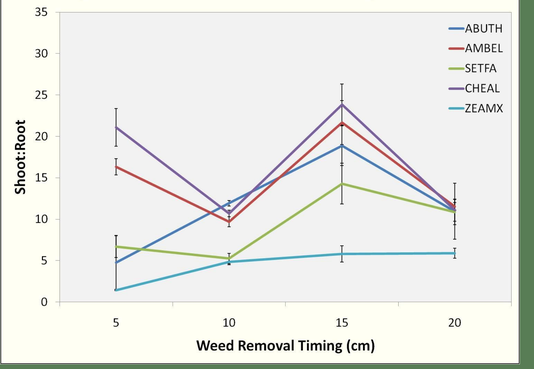


Figure 8. Shoot to Root Biomass Ratio at 202 kg N ha^{-1} Rate



Results and Discussion

- Ratios of nitrogen and biomass were lowest when weeds were grown under 0 kg N ha^{-1} at 15 cm (Fig. 1 and 2)
- Shoot:root nitrogen ratios at the 67 kg N ha^{-1} rate varied at 15 cm removal timing between weed species (Fig. 3), but biomass ratios were less variable at 15 cm timing (Fig. 4)
- A nitrogen rate of 134 kg N ha^{-1} resulted in weeds with large differences in shoot:root nitrogen ratios at 15 cm removal (Fig. 5), but more equal biomass ratios at the same removal timing (Fig. 6)
- Shoot:root nitrogen and biomass ratios at the 202 kg N ha^{-1} rate (Fig. 7 and 8), were lower than the other nitrogen rates, possibly due to more nitrogen availability
- Shoot:root nitrogen and biomass ratios at 5 cm (V3) removal across nitrogen rates was generally:
  - CHEAL > AMBEL = ABUTH > SETFA > ZEAMX
- Shoot:root nitrogen and biomass ratios at 15 cm (V5) removal across nitrogen rates was generally:
  - CHEAL $\geq$ AMBEL > ABUTH = SETFA > ZEAMX
- Reductions in the shoot:root nitrogen and biomass ratios at 10 cm (V4) and 20 cm (V6) removal timing
  - Root growth increased at these timings
  - Larger root systems may allow for increased nitrogen uptake from soil
- Ratios of weed species varied based on removal timing varied more than corn ratios

Conclusions

- Nitrogen and biomass partitioning is species specific
  - Corn generally had the lowest ratios
  - CHEAL tended to have the greatest ratios
  - SETFA was most similar to corn at 5 and 10 cm
- Root morphology did not affect biomass ratio, but impacted nitrogen ratios
  - SETFA root system was fibrous, whereas the CHEAL, AMBEL, and ABUTH had tap roots
  - Biomass ratios were not different at 15 cm for these species, but were significantly different in nitrogen ratios
- Partitioning varies over time
  - Shoot nitrogen and biomass were always greater than root nitrogen and biomass
  - Shoot nitrogen and biomass for most species was greater at 5 cm and 15 cm when compared to roots
  - Nitrogen ratios were similar across species at 10 cm regardless of nitrogen rate
- Nitrogen rate affected nitrogen and biomass ratios
  - Lower ratios under limiting nitrogen (0 kg N ha-1)
  - High nitrogen rates also evened ratios (202 kg N ha-1)

Future Studies

- Continue this project in 2011
- Investigate the effect of density and species on nitrogen and biomass partitioning between shoots and roots
- Examine how nitrogen partitioning affects seed production, dormancy, and fecundity for the species examined

References

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