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Nitrogen Accumulation by Annual Grass Weeds in Roundup Ready Corn Production

It is anticipated that adoption of Roundup Ready corn will proceed at a fairly rapid pace over the next couple of years in the eastern cornbelt. As growers adopt this technology, we anticipate that they will also begin shifting their weed control programs from those that rely heavily on soil-applied acetamide-atrazine premixes to those that are less reliant on the premixes and more reliant on postemergence glyphosate in Roundup Ready corn or glufosinate (Liberty) in Liberty Link corn. So, if adoption of Roundup Ready corn and changes in herbicide use patterns proceed as expected, we will be going from a system which was largely devoid of early-season weed pressure to a system where early-season weed infestations will be common and require broadspectrum postemergence herbicides for effective control and protection against yield loss. In addition, the current high prices of nitrogen fertilizer will also cause some growers to consider reducing nitrogen rates to cut costs of production.

It is important to understand that weeds are just like crop plants and will utilize soil nutrients in a similar manner to grow and reproduce. What is not well understood is how much nitrogen is utilized by weeds and the effect of nitrogen use by weeds will have on crop yields. Over the past 7 years, I have had a couple of my graduate students conduct research projects that involved nitrogen accumulation by weeds in corn and impact on corn yield. In the next couple of articles I will summarize the results of these projects.

The first project I will discuss was an evaluation of annual grass weed interference and nitrogen accumulation in no-till, Roundup Ready corn. The objective was to determine the interactive effects of grass weed interference and sid-dressed N applications on corn and weed growth and N content and corn yield. The experiment was conducted in 1999 and again in 2000 on a silt loam soil with 2.5% organic matter. The experimental area was a no-till site. Soil-applied broadleaf herbicides were applied to control broadleaf weeds and allow grass weeds to emerge with the corn. The grass weeds present in this study consisted of giant foxtail, barnyardgrass, and large crabgrass and a combined density of approximately 30 plants per square foot. Ammonium nitrate fertilizer was surface applied at 100 lb N/A just prior to planting. We utilized a relatively low or “threshold” rate of nitrogen in an attempt to tease out the effects of N accumulation by grass weeds on corn growth and yield.

The grass weeds emerged at about the same time or slightly later than the corn and were controlled with glyphosate when they were either 3, 6, 9, or 12 inches tall. After the grass weeds were controlled at the specific timings, the plots were kept weed-free for the remainder of the growing season. To determine if side-dress nitrogen could be utilized to overcome the effects of early-season grass weed competition, the weed removal timing treatments were duplicated and an additional 40 lbs of N/A was applied to those plots when corn was 2 feet tall. Corn and grass weed tissue samples and soil samples (2 feet deep) were collected from weedy and weed-free plots at each grass control timing and at corn harvest. Plant samples were analyzed for total Kjeldahl N and soil samples analyzed for nitrate and ammonium content. The experimental design was a randomized complete block with four replications each year.

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The results showed that grass weeds accumulate quite significant amounts of nitrogen on a per area basis. At the 3 inch removal timing, grass weeds contained similar amounts of N on a per area basis as corn. By the time grass weeds are 12 inches tall, they had 50 to 63 lbs of N/A in 1999 and 16 to 32 lbs of N/A in 2000. This amounts to about 3 times as much N as contained in corn biomass in 1999 when the grass weeds emerged with the corn, and about ½ as much N in corn biomass in 2000, when corn emerged about 10 days before the weeds emerged.

The main effect of weed removal height on corn yield was similar in both years. Corn yield and N content of corn biomass were similar to the weed-free controls with grass interference up to 6 inches in height before control measures were implemented. Yields were lower in treatments with grass weed interference until 9 inches or greater in height and there was less N in the corn biomass than the weed-free controls. Side-dress N had a positive effect on recovery of corn yield due to weed interference in 2000 when adequate late season precipitation was available, but had no effect on corn yield in 1999 when late-season precipitation was limited.

In summary, when grass weeds at a density of 30 plants per square foot emerge at the same time as corn, they should be controlled before reaching 6 inches in height to avoid excess N accumulation and crop yield loss. Surface-applied ammonium nitrate as a side-dress treatment was effective in overcoming the competitive effects of early-season weed interference in corn in a year with adequate late-season precipitation, but was not effective in a dry year. The best opportunity for utilizing side-dress N to recover yield due to weed interference will be to inject the N into the soil after postemergence weed control measures are conducted to minimize the amount tied up by microbes as they decompose the weed biomass on the soil surface.

Reference:
Hellwig, K. B., W. G. Johnson, and P. C. Scharf. 2002. Grass weed interference and nitrogen accumulation in no-tillage corn (Zea mays L.). Weed Sci. 50:757-762.