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Effect of Weed Removal Time on Corn Yield as Affected by Nitrogen Source and Rate

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Introduction

Two of the greatest factors, following genetics, impacting production and yield in agronomic crops are fertility and weed management. The uptake efficiency of nitrogen is dependent upon many factors including tillage system, soil type, crop, weeds, and the amount and type of nitrogen fertilizer applied. The relationship and interaction between crops and weeds is important, and determining how North Carolina corn production may be impacted by different fertilizers could improve nitrogen use efficiency and overall corn yields. Escobar et al. (2003) reported time release fertilizers will slowly give a N supply to a plant thus improving Nitrogen Uptake Efficiency and giving significantly higher yields. Nitrogen uptake efficiency is defined as total plant nitrogen per unit of soil nitrogen (Weih et al. 2011) and has been shown to have a strong positive correlation with crop biomass production, kernel number in corn, grain yield and photosynthesis (O'Neill et al. 2004).

It is important to consider what variables in a crop system will impact available nitrogen after application. According to Mussaddak (2008) it is important to understand the nitrogen uptake process, as well as nitrogen recovery within a plant in order to determine an accurate nitrogen application rate and time for fertilizer applications (Mussaddak 2008). Competition for nitrogen between crops and weeds results in reduced available nitrogen for uptake and utilization by the crop, and often alters the crop yield. This has been noted in many studies concerning the critical period of weed control, the period of time crop production will be negatively impacted if weed species are present (Knezevic et al. 2002). Competition occurs for space, sunlight, and nutrients. Weeds and crops have similar key macro and micronutrient requirements in order to survive.

Therefore, it is hypothesized that when weeds are allowed to grow to 7.62 or 15.24 cm (3 or 6 in.) in height, corn yield will be reduced compared to weed-free plots. Additionally, it is hypothesized that nitrogen rate will affect weed competition at various weed heights. The investigation of which fertilizer and weed removal time impacts yield will give farmers another way to improve yearly yields in NC.

Materials & Methods

Field studies were conducted at two locations in 2011 and repeated in 2012:
Central Crops Research Station in Clayton, NC
Upper Coastal Plains Research Station near Rocky Mount, NC

Roundup Ready field corn planted on May 2 and 3, 2011 (Rocky Mount and Clayton, respectively) and May 7 and 14, 2012.(Clayton and Rocky Mount, respectively)

Soil types
Clayton: Rains sandy loam, Varina loamy sand, Wagram loamy sand,
Norfolk loamy sand (2011); Rains sandy loam and L:ynchburg sandy loam (2012)
Rocky Mount: Goldsboro fine sandy loam, Norfolk loamy sand (2011); Goldsboro fine sandy loam and Norfolk loamy sands (2012)

Treatment factors included N source, N rate and weed removal time organized in a factorial treatment arrangement.

Nitrogen sources included:
urea ammonium nitrate (UAN)
chicken litter (CCL)
sulfur coated urea (SCU)

Nitrogen rates included:
0 kg N/A
27.22 kg N/A
54.43 kg N/A
81.65 kg N/A

Nitrogen from all sources was applied and incorporated immediately before planting.

Dominant Weed Species
Palmer amaranth (*Amaranthus palmeri*)
large crabgrass (*Digitaria sanguinalis*)
Purple nutsedge (*Cyperus rotundus*)
Yellow nutsedge (*Cyperus esculentus*)

Weeds were removed at:
0 cm (weed-free)
7.62 cm
15.24 cm

Weed control to maintain weed-free plots after the initial removal timing was achieved using glyphosate plus a premix of atrazine and *S*-metolachlor and hand weeding. Univariate analysis was used to remove outliers and, the two years were then analyzed separately using proc glm in SAS 9.3.

Fig. 1 Corn Yield as affected by Year averaged over Location, N source, N rate, and Weed Removal Height

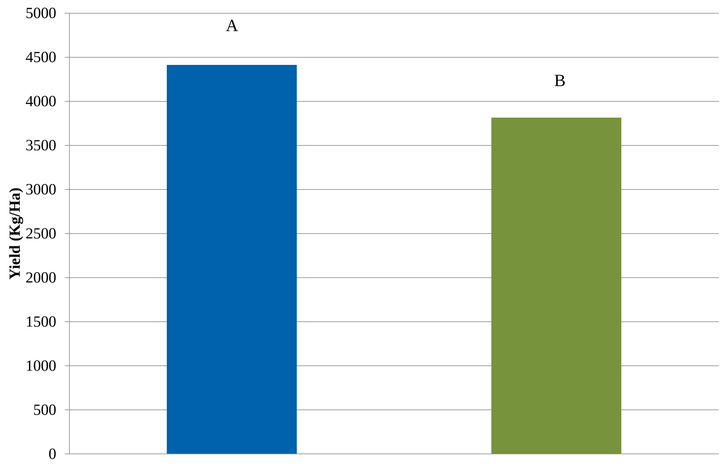


Fig. 2. Corn Yield as affected by Weed Removal Height averaged over Location, and N source.

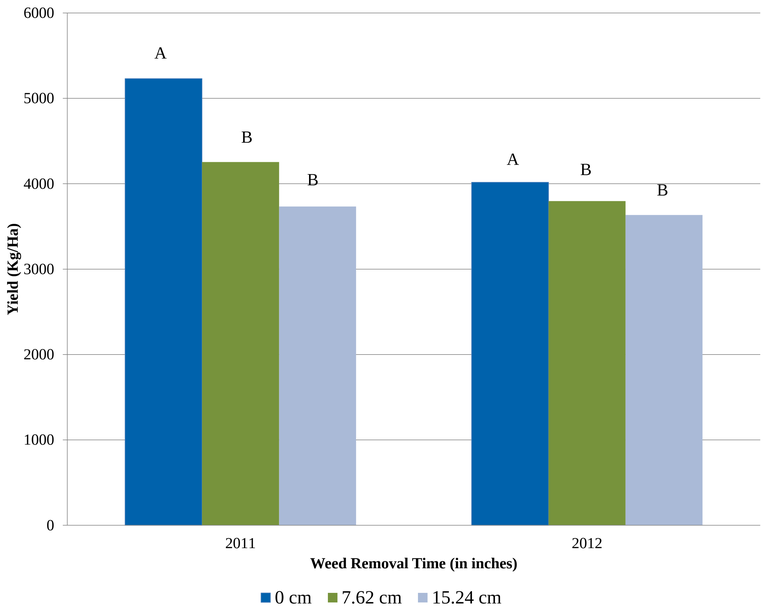
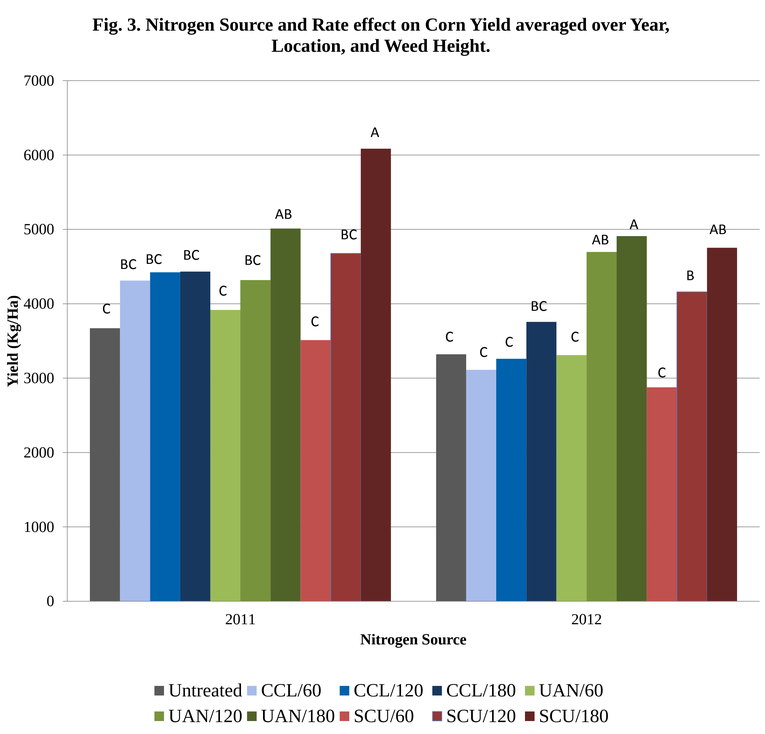


Fig. 3. Nitrogen Source and Rate effect on Corn Yield averaged over Year, Location, and Weed Height.



Results & Discussion

Significant year, nitrogen source, and weed removal height effects were observed for corn yield. Significant yield differences were observed between the two years (Figure 1). A number of factors may have contributed to this including weather differences as well as some differences in soil type in each year within each location. Both temperature and precipitation varied a great deal between the two years (data not shown).

When allowed to remain in the field with corn, weeds were able to compete with the corn for nitrogen over a greater time period therefore reducing corn yield potential. The reduction in yield due to weed competition (Figure 2) shows the importance of the critical time of weed removal with the weed-free (0 cm weeds) plots having significantly greater yields than either later weed removal height (7.62 cm and 15.24 cm weeds). This figure also indicates how weed removal timing affects the critical period for weed control. Other research has also shown growth of weeds during the critical period of crop growth will impact crop yield (Evans et al. 2003; Page et al. 2012).

Significant interactions were observed between nitrogen source and rate (Figure 3). The increased corn yield corresponding with an increase in applied nitrogen is expected, as nitrogen is an essential nutrient in corn production (O'Neill et al. 2004; Xu et al. 2010) and is partially due to the increase in Nitrogen Uptake Efficiency with greater nitrogen rates applied (Sisson et al. 1991). Crop yield was lower where composted chicken litter was applied compared to higher rates of other nitrogen sources. Although results are variable for yields in the urea and sulfur coated urea treatments, in 2011 greater corn yields were achieved where a delayed release product was used. Corn yields in 2012 were lower for all sources compared to 2011, and can be attributed to increased rainfall and subsequent leaching of nitrogen. Trends can be observed for the three sources across years, with greatest yields observed where higher rates of nitrogen were applied as urea or sulfur coated urea.

Overall, it can be concluded that the higher rates of synthetic fertilizers will produce higher yields (54.43 and 81.65 kg N/A of SCU and UAN). It is also evident that SCU has the capability to produce higher yields given optimal soil and weather conditions. These results also allow conclusions that maintaining a weed-free field from the start of the season will produce an optimal yield, while there will be no significant difference when the weeds are removed between the 7.62 and 15.24 cm range. Therefore, the current recommendation to farmers would be to apply an adequate rate of synthetic nitrogen fertilizer at the beginning of the season (SCU over UAN) and start your weed removal program PRE or PPI.

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