# EARLY GROWTH OF COTTON AND PALMER AMARANTH IN RESPONSE TO INORGANIC FERTILIZERS AND BROILER LITTER

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## Introduction

Inorganic fertilizer costs reached an all-time high in 2008. Uncertain and increasing prices are causing growers to consider alternate, but more economical, sources of nutrients. One such alternative is poultry (broiler) litter (manure mixed with bedding materials, which is readily available in the SE US. In GA in 2009, 12,008 poultry houses produced an average of 25,000 birds per house. Historically, most of the broiler litter used in the SE US has been applied to pastures and hay crops although an increasing number of producers in GA are using it in cotton production. This increased adoption of broiler litter has caused growers to question if and how chicken manure will affect the growth of both crops and weeds relative to traditional inorganic fertilizer sources. The objective of this study was to evaluate early season growth and development of cotton and Palmer amaranth in response to nutrient level (particularly N) and source.

## Materials and Methods

The study was conducted in a greenhouse in 2009. The fertilizer treatments consisted of a control (no fertilizer), 10-10-10 Super Rainbow Plant Food (to provide a total of 120-120-80 lbs/A inorganic N-P-K), 5-10-15 Rainbow Plant Food (to provide a total of 60-120-120 lbs/A inorganic N-P-K), and broiler litter (to provide a total of 120-120-80 lbs/A organic N-P-K). N rates of 120 lbs/A are recommended in such instances where deep, sandy soils exist or when cotton follows cotton. Fertilizers were thoroughly incorporated into potting soil (composted wood products, reed sedge, peat, and perlite) using a steel cement mixer. Plastic pots (138 cubic inches) were filled with the soil-fertilizer mixes and were arranged randomly on the greenhouse benches. Pots were seeded with either cotton (Roundup Ready Flex and Widestrike) or Palmer amaranth (glyphosate-resistant [GR] and susceptible [GS]). Following emergence, all pots were thinned to one plant/pot. Pots were watered daily; no supplemental fertilizers were applied. The height in inches and the number of expanded leaves/plant were recorded at 14, 21 and 28 days after planting (DAP). Each nutrient treatment (none, 10-10-10, 5-10-15, broiler litter) by variety/biotype (Roundup Ready Flex cotton, Widestrike cotton, GR Palmer, GS Palmer) combination was replicated five times; the entire experiment was conducted twice. Plant height and leaf production data were statistically analyzed using SAS software; cotton and Palmer amaranth data were analyzed separately.

## Cotton Results

Statistical analyses indicated that there were no differences between the Roundup Ready Flex and Widestrike varieties with respect to growth and leaf production; significant differences in early cotton development were observed among the fertilizer treatments (Figures 1 and 2). At 14 DAP, cotton plants grown in soil amended prior to planting with the 10-10-10 Super Rainbow formulation were an average of 4.92 inches in height, whereas cotton grown in the absence of fertilizer or using 5-10-15 Rainbow Plant Food and broiler litter as nutrient sources ranged from 3.2 to 3.4 inches in height (Figure 1). At 21 and 28 DAP, cotton grown using 10-10-10 fertilizer was 5.4 and 6.0 inches tall respectively; these heights were significantly greater than the heights (3.4 to 4.2 inches) obtained for the other treatments. There were no significant differences in height among cotton plants grown using 5-10-15 or broiler litter as a fertilizer source and cotton plants in the non-fertilized control. Leaf production at 21 and 28 DAP was significantly affected by fertilizer treatment (Figure 2). At 21 DAP, cotton grown using the 10-10-10 fertilizer source produced an average of 2.1 leaves/plant as compared to an average of 1.1 to 1.5 leaves/plant for the other treatments. At 28 DAP, cotton in the 10-10-10 treatment produced almost 3 leaves/plant as compared to an average of 1.6 to 1.7 leaves for the 5-10-15, broiler litter, and non-fertilized treatments.

## Palmer Amaranth Results

Statistical analyses indicated that there were no differences between the GR and GS Palmer amaranth biotypes with respect to growth and leaf production; significant differences in early Palmer amaranth development were observed among the fertilizer treatments (Figures 3 and 4). For all observation periods, Palmer amaranths grown using the 10-10-10 Super Rainbow formulation were significantly taller (2.4 to 3.5 inches) than the plants grown using broiler litter (1.1 to 1.6 inches) or 5-10-15 Rainbow Plant Food (0.7 to 0.8 inches) as a nutrient source and the plants in the non-fertilized control (0.4 inches) (Figure 3). For all three evaluation periods, the plants produced using broiler litter as a nutrient source were significantly taller (175% to 310%) than those grown using the 5-10-15 fertilizer than those in the non-fertilized control. Leaf production at all observation periods was also significantly affected by fertilizer treatment (Figure 4). At 14 DAP, Palmer amaranths grown using the 10-10-10 and broiler litter as a fertilizer source produced an average of 1.9 and 2.2 leaves/plant, respectively as compared to the other treatments (0 to 0.9 leaves/plant). At 21 and 28 DAP, Palmer amaranths in the 10-10-10 treatment produced an average of 6.5 leaves/plant as compared to averages of 0.9 to 3.6 leaves/plant for the 5-10-15 and broiler litter treatments. At 21 and 28 DAP, Palmer amaranths grown using broiler litter as a nutrient source produced 211% and 260% more leaves/plant, respectively, than those in the 5-10-15 treatment.

## Discussion

The local availability of broiler litter, coupled with the rising costs of inorganic fertilizers, has increased GA growers' interest in using chicken manure as a source of macro and micronutrients for row crop production. Before including manures into their cotton systems, growers will need to know if and how crop and weed growth will be affected. Palmer amaranth can grow rapidly (up to several inches per day), which means that the window of time available for postemergence chemical control can be quite short.

Enhanced growth of palmer amaranth when using broiler litter as fertilizer could significantly impact management options. Results from this study indicate that cotton grew taller and produced more leaves when 120 lbs/A N were applied preplant as an inorganic fertilizer (10-10-10) as compared to the non-fertilized control, when 60 lbs/A N were applied as an inorganic fertilizer (5-10-15), and when 120 lbs /A N was applied as a manure. Although the total amount of N applied using broiler litter was equal to that of the 10-10-10 fertilizer, the amount of available N was, most likely, significantly less. According to the GA cotton production handbook, only 60% (72 lbs/A) of the total N in broiler litter is made available for the crop during the growing season. The use of 5-10-15 and broiler litter as nutrient sources did not improve cotton growth and development over the non-fertilized control. Unlike cotton seed, which has a large endosperm (and, therefore, greater internal nutrient reserves to facilitate early plant growth), the seed of Palmer amaranth is small (~1 mm). Readily available external sources of N are likely to be more crucial for Palmer amaranth to ensure plant establishment. Future studies will be needed to evaluate the development of Palmer amaranth using common crop production practices, including split inorganic nitrogen applications, and in the presence and absence of irrigation.

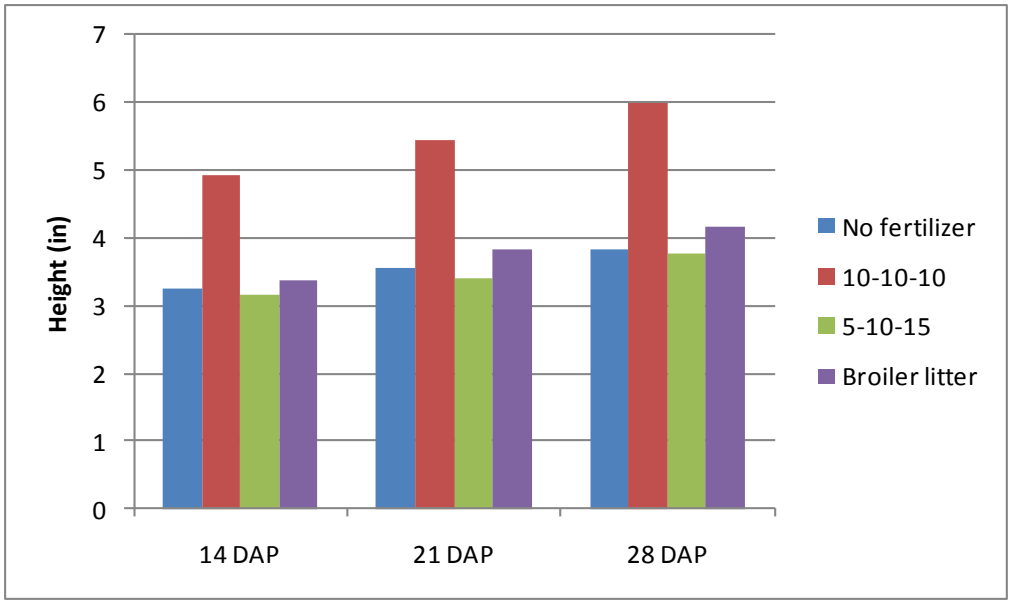


Figure 1. Height in inches of cotton 14, 21, and 28 DAP in response to fertilizer source. Cotton grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources were significantly smaller than cotton grown using 10-10-10 for all observation periods.

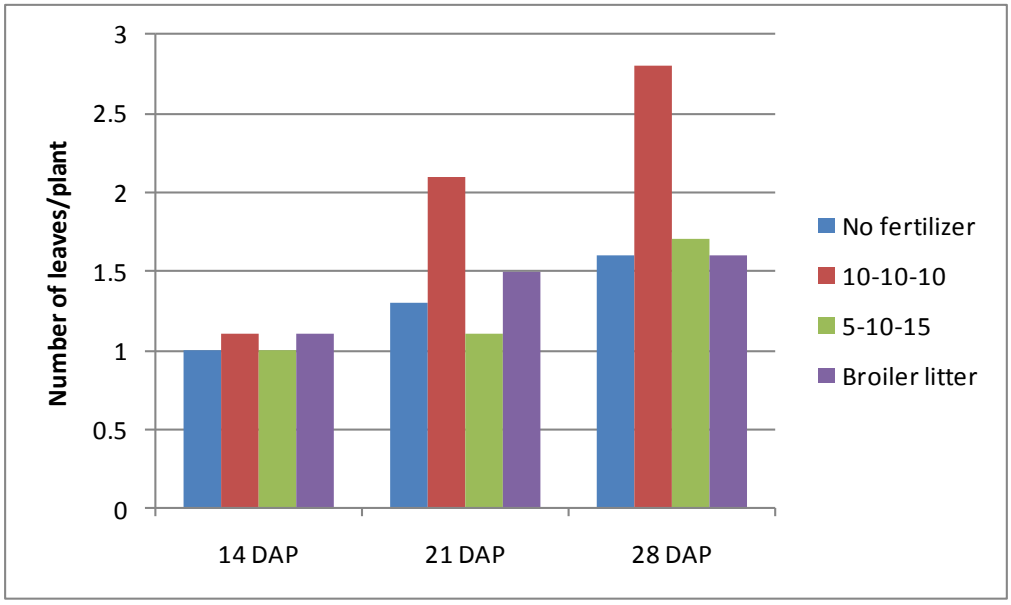


Figure 2. Number of leaves /cotton plant 14, 21, and 28 DAP in response to fertilizer source. Cotton grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources produced significantly fewer leaves per/plant than cotton grown using 10-10-10 at 21 and 28 DAP.

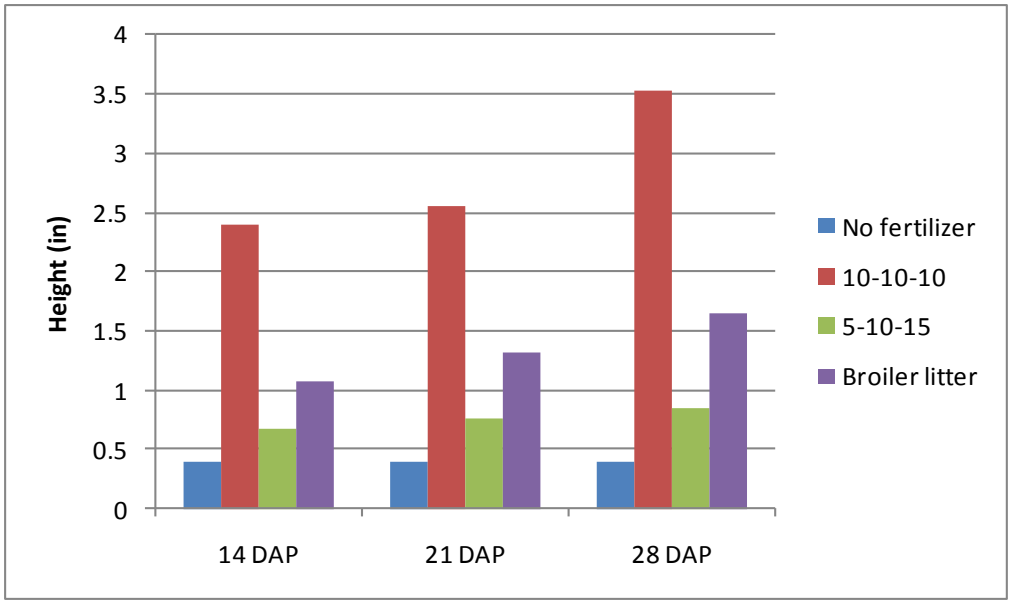


Figure 3. Height in inches of Palmer amaranth 14, 21, and 28 DAP in response to fertilizer source. Palmer amaranths grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources were significantly smaller than Palmer amaranths grown using 10-10-10 for all observation periods. Palmer amaranths grown using broiler litter were significantly taller than those grown using the 5-10-15 fertilizer.

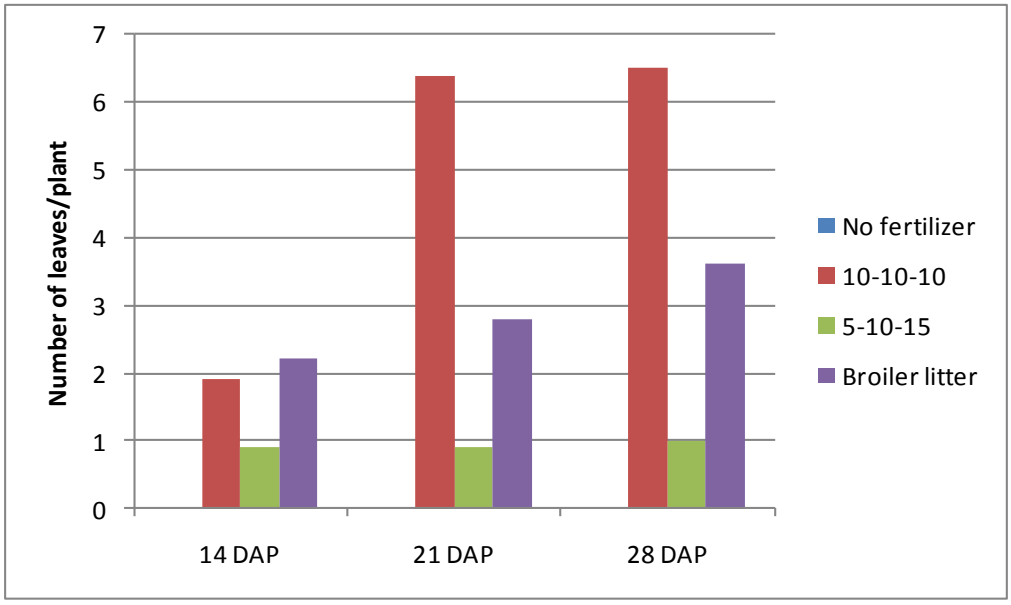


Figure 4. Number of leaves/Palmer amaranth plant 14, 21, and 28 DAP in response to fertilizer source. Palmer amaranths grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources produced significantly fewer leaves/plant than Palmer amaranths grown using 10-10-10 for all observation periods. Palmer amaranths grown using broiler litter had significantly more leaves/plant than those grown using the 5-10-15 fertilizer.