

POTASSIUM AND CULTIVAR EFFECTS ON CARBOHYDRATE  
PARTITIONING IN UPLAND COTTON

A Thesis  
Presented for the  
Master of Science  
Degree  
The University of Tennessee, Knoxville

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May 2006

## ABSTRACT

The indeterminate growth habit of upland cotton (*Gossypium hirsutum* L.) reduces the efficiency of yield formation when grown as an annual for its lint. Altering the determinacy may provide greater carbohydrate partitioning to reproductive structures, allowing higher yields. Another factor that may influence partitioning is potassium (K) nutrition. Potassium is essential for physiological and biochemical processes including translocation. It is necessary for ATP production, which is crucial for phloem loading and unloading. A three-year experiment was conducted at the West Tennessee Research and Education Center to evaluate carbohydrate partitioning in Paymaster 1218BG/RR (PM1218), a relatively determinate cultivar, and Deltapine 555BG/RR (DP555), a more indeterminate variety. The two cultivars were grown in the field under two levels of potassium fertilization, 60 and 120 lbs K<sub>2</sub>O/acre/year, representing adequate and excessive K fertility, respectively. Plots containing cultivars and K treatments were arranged in randomized complete blocks with six replications per year. Plant samples were harvested at early bloom and after cutout, to evaluate partitioning during boll filling. Eight stem samples per plot were collected immediately below the cotyledonary node, freeze dried and ground for carbohydrate analysis by enzymatic methods. The two sampling dates were treated as subplots in the statistical analysis. Plots were mechanically harvested and samples of seedcotton were ginned to determine lint yields. Results showed that K had significant effects on monosaccharide concentrations of both cultivars and on lint yields of PM1218. Lint yields of PM1218 were lower than DP555 with 60 lb K<sub>2</sub>O/ac/yr, but were equivalent at 120 lb K<sub>2</sub>O/ac/yr. Total soluble sugar

concentrations were higher in DP555 than in PM1218 at early bloom but declined to equivalent concentrations after cutout. Starch analysis revealed both a cultivar and harvest sample date interaction. In all years, PM1218 had more starch than DP555 at early bloom. Accumulation or depletion of starch reserves during boll filling differed by year, along with lint yields. Relating these results to shoot biomass data, also collected at both harvest dates for another study, confirms that the determinate variety PM1218 allotted more photoassimilates for reproductive growth during this time than DP555, despite similar lint yields. Previous research has found decreased vegetative growth during reproductive development in more determinate cultivars. Lower lint yields in PM1218 at 60 lbs  $K_2O/ac/yr$  could be due to soil nutrient uptake efficiency and may explain the need for additional potassium in the more determinate cultivar. The two cultivars differed in carbohydrate concentrations at early bloom but by cutout were similar. Further investigation into the components of carbohydrate sink strength, such as seed constituents and root growth, may help in determining the carbohydrate partitioning trends of cultivars. Additional research is needed to establish potassium fertilization for optimum reproductive partitioning in determinate cultivars.

To the Graduate Council:

I am submitting herewith a thesis written by Jenny Dale Clement entitled "Potassium and Cultivar Effects on Carbohydrate Partitioning in Upland Cotton." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Plant Sciences.

C. Owen Gwathmey  
Major Professor

We have read this thesis  
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