

Do Contemporary Cotton Cultivars Respond Differently to Potassium Fertilization?

By C. Owen Gwathmey

Contemporary upland cotton cultivars may differ in their potassium (K) nutrition requirements to achieve optimum yields. Researchers have offered several possible explanations for varietal differences in yield response to K, including differences in earliness of maturity and in partitioning of the products of photosynthesis within the plant. This article summarizes some Tennessee research in progress to investigate these relationships.

Earliness of maturity is important to the adaptation of cultivars to different parts of the U.S. cotton belt, especially where season length is marginal for cotton, as in the North Mississippi River Delta. Earliness is enhanced when a greater proportion of new photosynthate is partitioned to bolls instead of more vegetative growth. This reduces the number of new fruiting sites, thus limiting the number of late-set bolls. By contrast, cultivars that continue to grow vegetatively during boll filling are said to be physiologically indeterminate. Production of new fruiting sites and foliage late in the season delays their maturity and harvest.

Role of K—Potassium is an essential nutrient for many physiological processes, most notably for the transport of the products of photosynthesis within the plant. It does this by regulating the salt balance across cell membranes. Improved transport of photosynthate to active growing points may be expected to promote vegetative growth. We wondered if increasing K fertility might promote late-season vegetative growth more in an indeterminate cultivar than in a more determinate cultivar.

Field research—A field study was conducted in 2003 and 2004 on a no-till Loring (thermic Oxyaquic Fragiudalf) silt loam at

the West Tennessee Experiment Station in Jackson, Tennessee, to determine effects of K nutrition on lint yield, earliness, and dry matter partitioning of two contrasting cultivars. Replicated, long-term K plots were maintained by broadcasting 60 or 120 lb K_2O/A as KCl before planting each year. Residual K fertility of each plot was estimated by soil sampling and analysis by Mehlich 1 procedures prior to annual K fertilization. Plots were also fertilized with 80 lb nitrogen (N) and 60 lb P_2O_5/A . Cultivars were the early-maturing PM 1218 BG/RR and the later, more indeterminate DP 555 BG/RR. Aboveground portions of eight plants per plot were harvested at early bloom and after cutout. These plants were dissected, dried, and weighed to measure biomass partitioning. Later, plots were spindle-picked twice to determine lint yields. Earliness was calculated as the percent of total yield picked at first harvest.

Soil test K—In plots receiving 60 lb K_2O/A /year, residual soil test K averaged 204 and 219 lb K/A in 2003 and 2004, respectively. These Mehlich 1 soil K levels correspond to the recommended K fertilization rate of 60 lb K_2O/A , according to the University of Tennessee Extension Service. Plots receiving 120 lb K_2O/A /year had residual soil test of 301 and 395 lb

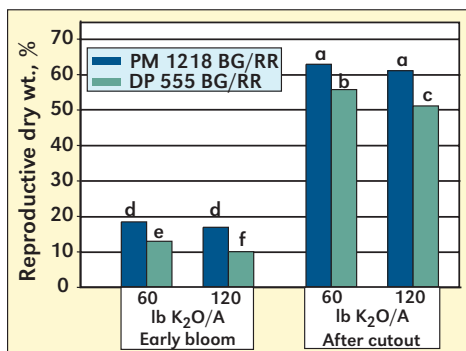


Figure 1. Effect of K nutrition on proportion of biomass in reproductive tissue at early bloom and after cutout of two cotton cultivars at Jackson, Tennessee, 2003-04.

K/A in 2003 and 2004, respectively. These soil K levels correspond to recommended rates of 60 and 0 lb K₂O/A, respectively, indicating that these plots received K above the agronomic optimum.

Biomass partitioning—Figure 1 shows the effect of K regime on the proportion of biomass in reproductive tissue of the two cultivars in 2003-04. As expected, the earlier cultivar partitioned more aboveground biomass to reproductive tissue than the later, indeterminate cultivar did. Potassium nutrition did not significantly alter the reproductive partitioning of PM 1218 BG/RR, but DP 555 BG/RR partitioned a smaller proportion of biomass to reproductive tissue at the higher K rate than it did at the lower K rate, both at early bloom and after cutout. This result suggests the additional K promoted more vegetative growth in the indeterminate cultivar.

Lint yield and earliness—Figure 2 shows the effect of K regime on 2-year average lint yield and earliness of the two cultivars. Yield of the earlier cultivar increased 11% in response to the additional K, while yield of the later cultivar did not increase significantly. This result is consistent with the different partitioning responses to K shown in Figure 1. Evidently, partitioning to vegetative growth in DP 555 BG/RR did not promote additional

yield formation at the higher K rate. Bolls set very late in the season are not expected to contribute much to yield in Tennessee, due to lack of heat units needed for them to mature. Figure 2 also shows the relative earliness of maturity of each cultivar in response to K. The expected cultivar difference in maturity is evident, but the delayed maturity in response to additional K was not statistically significant. Differences in cultivar maturity were also evident in canopy appearance late in the growing season (Figure 3).

Contemporary cotton cultivars that differ in earliness and growth habit may respond differently to annual K fertilization that exceeds recommended rates. If the additional K promotes the partitioning of photosynthetic products to vegetative growth instead of reproductive parts, then lint yield formation may not be enhanced. Additional research is needed to determine the role of K in the storage and

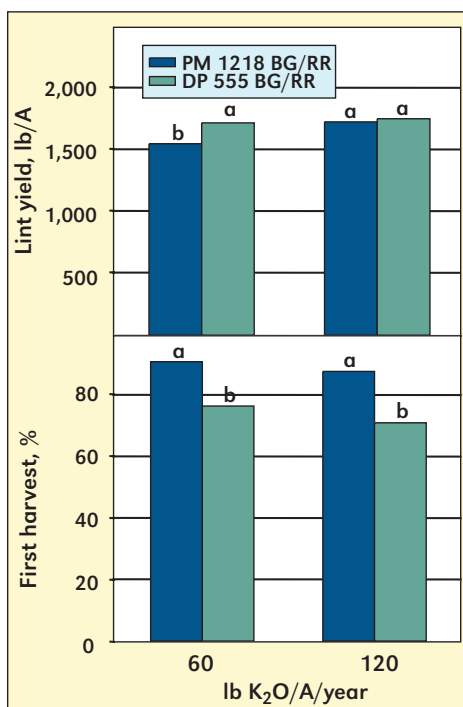


Figure 2. Effect of K nutrition on lint yield and earliness of two cotton cultivars at Jackson, Tennessee, 2003-04.



Figure 3. Cultivar differences in canopy appearance at 114 days after planting in 2004 at Jackson, Tennessee.

Humic Materials...from page 7

However, there is currently not enough research to explain possible mechanisms and accurately predict when humic materials might prove beneficial. There are reports of growth and yield responses from various conditions...from soil and foliar application...banded, broadcast, and fertigated applications...and solid and liquid humic formulation. Thus, defining the positive effect is difficult.

A benefit sometimes mentioned regarding humic material is that it can provide a carbon (C) source for soil microorganisms. This mechanism does not appear to be likely, since a typical application of 5 to 20 gal/A of humic material will supply only 3 to 15 lb C/A. Compare this with more than 4,000 lb of C/A returned in the residue of a typical corn crop. The hormonal effect of humic materials on plant growth has also been carefully studied and largely negated. Humic acids have been shown to function as a urease inhibitor and a nitrification inhibitor in some circumstances. The search for a biological explanation for

remobilization of carbohydrates in these cultivars, to improve their efficiency.

In short season environments like Tennessee, the likelihood of a satisfactory cotton crop is promoted by planting well-adapted, early maturing cultivars and managing them for earliness. **An important element in earliness management is a K fertility maintenance program based on annual soil test results and local extension recommendations. BC**

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the plant responses to humic materials will continue and will not be simple.

The use of humic materials in production agriculture continues to grow. There are numerous reports of both successful and unsuccessful use of these materials. Due to the wide variation in their raw materials and processing methods, it is difficult to accurately compare the efficacy of specific commercial products without careful study. Due to the range of recommendations for use, it is not easy to define a mode of action that can be applied across many crops, soils, and growing conditions.

Users of humic materials should keep careful records and conduct on-farm field trials to determine product effectiveness. Research organizations should continue to study the value of this expanding agricultural input. Remember that no additive will compensate for poor management and inadequate crop nutrition. **BC**

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