LONG-TERM COTTON YIELD RESPONSE TO POTASSIUM AND PHOSPHORUS APPLICATIONS

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Abstract

Potassium (K) and phosphorus (P) are essential to the growth and development of cotton. Phosphorus is necessary for plant metabolism and encourages early root formation and growth, vigorous plants, early fruiting, and plant maturity, while K is known to play an important part in photosynthesis, plant-water relations, enzyme activation, disease resistance, and fiber development. Not all P and K is positionally or chemically available during the growing season. With the fast-fruiting, early-maturing cotton cultivars the availability and uptake of both P and K is essential for optimum production. A long-term study was initiated in 1982 at the Delta Research and Extension Center on a Dundee vf sandy loam (Aeric Ochraqualfs) to evaluate the long-term effects of P and K fertilization on cotton lint production. A 3 x 3 factorial arrangement of P rates (0, 40, 80 lb P/A) and K rates (0, 60, 120 lb K/A) were included in a randomized complete block design with four replications. The fertilizer P (applied as concentrated superphosphate (CSP), 0-46-0) and K (applied as muriate of potash, 0-0-60) was applied in even years of the continuing study. The dry materials were broadcast-applied to partially flattened beds followed by incorporation with a spring-tooth harrow and re-hipping. All other cultural practices were maintained as appropriate for conventional cotton production. Composite soil samples were taken each year after harvest, then processed and analyzed through the Soil Testing and Plant Analysis Laboratory at Mississippi State University operated by the Mississippi Cooperative Extension Service. These samples were used to monitor changes in soil test P and K with respect to fertilizer applications. Those plots receiving no fertilizer P and K were allowed to continue a gradual decline in available nutrients throughout the duration of the experiment.

Through the first phase of the investigation (1982-1988) there was no significant response to the additions of P or K with respect to lint production. Main effect lint yields were 1274, 1235, and 1220 lb lint/A for the 0, 60, and 120 lb K/A rates, respectively, averaged across the P rates. Lint yields were 1245, 1218, and 1267 lb lint/A for the 0, 40, and 80 lb P/A rates, respectively, when averaged across K levels. Soil analyses through the first phase of the study showed a gradual decline in soil test P with time for the 0 lb P/A rate and a distinct difference in soil test levels among P rates. Even with no P applied, soil test levels through the first six years exceeded 100 lb P/A which fell into the high soil test range where no response to additional P would be expected. Potassium soil test levels were more complicated, as the actual levels of K in the soil were lower with the 120 lb K/A rate compared to the 60 lb K/A rate. This effect was largely related to spatial variability in the field with plots receiving little fertilizer K testing higher than plots receiving high levels of fertilizer K from the outset of the study. It is doubtful that plant uptake or luxury consumption could account for the differences in soil test levels without differences in total production. With time, there was an increase in soil test K where 120 lb K/A was being applied.

In the second phase of the study (1989-1993) the 8-row plots originally established were split, and a nitrogen (N) rate component (100 and 150 lb N/A) was included as a subplot. There was no significant response to an increased N rate and again no response to either P or K fertilizer applications. During the second phase of the study, soil tests were inconsistent from year to year and did not seem to relate to actual yields. Changes in laboratory techniques and instrumentation probably accounts for some variability. In general, with the variability in soil tests levels between plots, little cotton response could be attributed to the various combinations of fertilizer P and K. In order to try and explain lint yields with respect to P and K levels, correlation of relative lint yield to soil test levels of P and K are planned. This determination can uncouple soil test levels and fertilizer applications for both the first and second phase of the study. The plots will continue to be monitored and maintained in order to create a large data base of yield to soil test correlations. At the low P and K rates, the soil test levels should continue to decline. Results from studies of this nature can be confounded by inherent soil variability but with new technology to examine spatial variability, researchers may be able to better explain results that do not fit traditional expectations.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:611-611 (1997)
National Cotton Council, Memphis TN