# EVALUATION OF COTTON NUTRIENT CONTENT UNDER VARIOUS SOIL-APPLIED FERTILITY PROGRAMS

**Andrea Althoff**
**Bradley Wilson**
**Cayden Catlin**
**Dr. Brian Arnall**
**Dr. Seth Byrd**
**Oklahoma State University**
**Stillwater, OK**
**Dr. Katie Lewis**
**Texas A&M AgriLife Research**
**Lubbock, TX**

## Abstract

Cotton (*Gossypium hirsutum*) yield may become limited when inadequate amounts of fertilizer are supplied during the season. Nitrogen (N), Phosphorus (P), and Potassium (K) are needed in greater quantities to optimize cotton production. Cotton nutrition has been subject to several studies from the 1900s through early 2000's (White, 1914; Olson and Bledsoe, 1942; Hearn, 1981; Mullins and Burmester, 1990; Mullins and Burmester, 2010). These authors investigated nutrient content in terms of plant uptake of N, P, K in differing plant parts and total plant uptake of various cotton cultivars. Many of these studies were conducted in low yielding production environments. Rate and uptake of nutrients are increased at flowering and decreased as bolls mature (Mullins and Burmester, 2010) Leaf nitrogen content is increased at cotton flowering and is decreased at maturity (Thompson et al., 1976; Zhu and Oosterhuis, 1992) Halevy, 1976 reported total uptake with lint yields greater than 1700 kg/ha: nitrogen uptake (224 to 234 kg/ha), phosphorous uptake (44 to 46 kg/ha), potassium uptake (164 to 184 kg/ha) in mature cotton. The objective of this study was to investigate nutrient uptake in cotton of various soil applied fertility programs in high a yield environment. Also evaluate nutrient content of differing plant parts (Nitrogen, Potassium, and Phosphorous) at peak nutrient demand timings and at harvest. Determine total uptake in mature plants of N, P, and K. Finally, investigate effects on cotton yield of various soil applied fertilizer programs in a high yield environment. The hypothesis of this experiment was that more nutrient uptake of Nitrogen and Potassium would occur than Phosphorus.

The location of this project was in Fort Cobb, Oklahoma. The variety Phytogen® 300 W3FE was planted. The field was irrigated with a center pivot. The base fertility application was made May 28, 2019 and June 3, 2020. All fertility applications were done by hand and there were four fertility applications made. The first treatment was non-treated check (NTC), this treatment applied no fertilizer. The next treatment consisted of nitrogen application only (N-Only), which applied 134 kg/ha. The next treatment was our base (BASE) treatment, which was 134 kg/ha of nitrogen for both years, in 2019 56 kg/ha of phosphorus and 50 kg/ha of potassium, and in 2020 17 kg/ha of phosphorus and 28 kg/ha of potassium. The final treatment was the base plus application (BASE +). The BASE + had 134 kg/ha of nitrogen for both years, in 2019 94 kg/ha of phosphorus and 76 kg/ha of potassium, and in 2020 33 kg/ha of phosphorus and 56 kg/ha of potassium. The planting date was June 6, 2019 and May 21, 2020. The soil type was Binger fine sandy loam. The first plant sample date was during peak bloom, this was August 7, 2019 and July 21, 2020. Two plants per plot were partitioned into leaf, reproductive structures (squares, flowers, bolls), and reproductive stems. Fresh and dry weights collected from each plant part partitioned. Plant tissue was ground using forage grinder for tissue nutrient concentration analysis. The second plant sample date was during 50-60% open bolls, on October 8, 2019 and September 22, 2020. Two plants per plot were sampled and partitioned into leaf, reproductive stems, lint from mature open bolls, seeds, and burs. Plots consisted of four rows, 0.9m by 9m. There were four replications in a randomized complete block design. All data was subjected to SAS 9.4 in analysis of variance (ANOVA) using a PROC MIXED Model. Means were separated using Fisher's Protected LSD at $\alpha = 0.05$. Year significant at $\alpha = 0.05$; Data will be shown by year.

In conclusion, uptake in leaves, stem, fruit, seed, lint and burrs were not significantly different at either sampling date between fertilizer programs. Although nitrogen uptake at peak bloom was greater in leaves and was redistributed to seed at maturity across fertility programs. Total nitrogen uptake ranged from 169 kg/ha to 207 kg/ha. This data agrees

with Hodges, (1991) who reported N uptake exceeded 200 kg/ha. Phosphorus uptake was greatest in leaves at peak bloom, however at maturity phosphorus uptake was greater in seed. Potassium uptake was greatest in leaves at peak bloom and was redistributed to burr and seed at maturity. No effect of fertility program on lint yield.

## References

Halevy, J. (1976) Growth rate and nutrient uptake of two cotton cultivars grown under irrigation. Agron J. 68:701-705.

Hearn, A.B. (1981) Cotton Nutrition. Field Crop Abstracts. 34:11-34.

Hodges, T. (1991) Temperature and water stress effects on phenology. p. 7-13. In: T. Hodges (ed.). Predicting Plant Phenology. CRC Press., Inc., Boca Raton, FL.

McConnell J. S., R. E. Glover, E. D. Vories, W. H. Baker, B. S. Frizzell & F. M. Bourland (1995) Nitrogen fertilization and plant development of cotton as determined by nodes above white flower, Journal of Plant Nutrition, 18:5, 1027-1036,

Mullins, G. L. and C. H. Burmester. (1990) Dry matter, nitrogen, phosphorus, and potassium accumulation by four cotton varieties. Agron. J. 82:729-736.

Mullins, G. L.; Burmester, C. H. (2010). Chapter 9 Relation of Growth and Development to Mineral Nutrition. In Physiology of Cotton pp. 97-105.

Olson, L.C. and R.P. Bledsoe. (1942) The chemical composition of the cotton plant and the uptake of nutrients at different stages of growth. Georgia Agric. Exp. Stn. Bull. 222.

Thompson, A.C, H.C. Lane, J.W. Jones, and J.D. Hesketh. (1976) Nitrogen concentrations of cotton leaves, buds and bolls in relation to age and nitrogen fertilization. Agron. J. 68:617-621.

Wells, R.; Meredith, W. (1984). Comparative Growth of Obsolete and Modern Cotton Cultivars. I. Vegetative Dry Matter Partitioining. Crop Science Society of America.

White, H.C. (1914) The feeding of cotton. Georgia Agric. Exp. Stn. Bull. 108.

Zhu, B., and D.M. Oosterhuis. (1992) Nitrogen distribution within a sympodial branch of cotton. J. Plant Nutr. 15:1-14.