

Calcium, Magnesium and Sulfur Uptake by Cotton

By G.L. Mullins and C.H. Burmester

Four modern varieties of cotton accumulated similar amounts of secondary nutrients in a recent study. Distribution in various plant parts and rate of accumulation during the season were also similar.

THE MOST RECENT intensive study of the calcium (Ca) and magnesium (Mg) nutrition of cotton grown in the U.S. was published in the early 1940s. For sulfur (S), there has never been an intensive study on cotton. A lack of attention to the needs for these nutrients is probably due to the infrequent reports of Ca, Mg and S deficiencies in cotton. Since the early 1940s, cotton varieties and cultural practices in the U.S. have changed. Due to genetic diversity, modern cultivars may differ from one another in their ability to accumulate Ca, Mg and S.

Non-irrigated field studies were conducted for two years in Alabama to evaluate nutrient uptake by different cotton varieties. The study was conducted on a

fertile Decatur silt loam in north Alabama and a Norfolk sandy loam soil in central Alabama. Soil pH was approximately 6.0 at both locations as a result of previous additions of dolomitic limestone. No further applications of Ca, Mg or S were made during the two years of this study.

Four genetically varied cotton varieties were compared at each location: (1) Deltapine 90 (an Acala cotton); (2) Coker 315 (a Midsouth cotton resulting from Carolina breeding); (3) Stoneville 825 (a Midsouth cotton from Delta breeding); and (4) Paymaster 145 (developed for the High Plains of Texas). Nutrient uptake was evaluated by harvesting whole plants at two-week intervals throughout the season, beginning approximately 15 days after

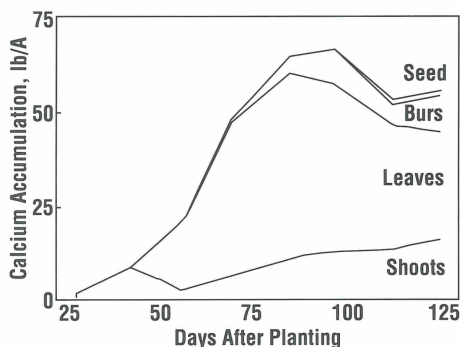


Figure 1. Average uptake of Ca by four cotton varieties grown on a Decatur soil in 1987. Sampling was initiated 30 days after planting and continued at 14-day intervals throughout the growing season. Reprinted by permission of the American Society of Agronomy.

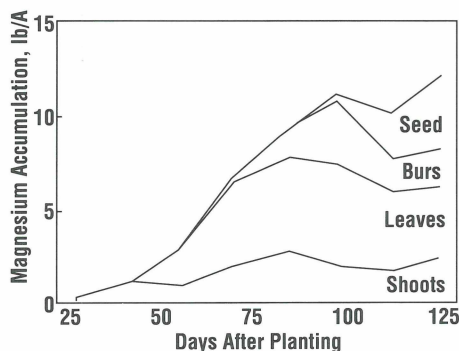


Figure 2. Average uptake of Mg by four cotton varieties grown on a Decatur soil in 1987. Sampling was initiated 30 days after planting and continued at 14-day intervals throughout the growing season. Reprinted by permission of the American Society of Agronomy.

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Table 1. Accumulation of Ca, Mg and S by mature cotton plants (average of four varieties) on two soils.

Plant part	Ca	Mg	S
	-----lb/A-----		
Stems	10.9	2.7	2.6
Leaves	37.3	6.1	7.5
Burs	7.8	2.3	4.2
Seed	1.6	5.0	3.9
Total uptake	57.3	16.1	18.2

emergence. Harvested plants were separated into stems, leaves and fruit for dry matter and nutrient analysis. Bolls were further separated into seed, burs and lint. The bur fraction included squares, flowers and immature bolls. All plant parts except lint were analyzed for Ca, Mg and S. See **Figures 1, 2 and 3.**

Total Nutrient Accumulation

The four varieties were very similar in their ability to accumulate Ca, Mg and S. There were no consistent differences among the four varieties in total Ca, Mg and S uptake or uptake by a given plant part. At the last sampling for each year, total Ca, Mg and S averaged over varieties and soils were 57.3, 16.1 and 18.2 lb/A, respectively, shown in **Table 1.** Magnesium uptake was similar for the two soils, but total Ca and S uptake was lower on the Norfolk soil compared to the Decatur soil. The Norfolk soil has a lower clay content and lower levels of extractable Ca and S as

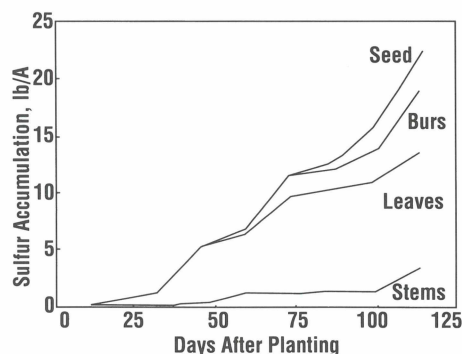


Figure 3. Average uptake of S by four cotton varieties grown on a Decatur soil in 1986. Sampling was initiated 36 days after planting and continued at 14-day intervals throughout the growing season. Reprinted from J. Plant Nutr. 16(6), p. 1077, by courtesy of Marcel Dekker Inc.

Table 2. Distribution of Ca, Mg and S in mature cotton plants (average of four varieties) on two soils.

Plant part	Ca	Mg	S
	----- % of total uptake -----		
Stems	19	17	14
Leaves	64	38	39
Burs	14	14	22
Seed	3	31	25

compared to the Decatur soil. Total nutrient uptake values were similar compared to older cultivars used in previous studies.

Nutrient removal by the seed represented 3 percent of the total plant Ca, 31 percent of the Mg and 25 percent of the total S, listed in **Table 2.** Yield of seed cotton averaged 1,874 lb/A. Combining yield data, available ginning data and total uptake data showed that an average of 7.6 lb of Ca, 2.1 lb of Mg and 2.4 lb of S were accumulated for every 100 lb of lint produced.

Maximum Daily Nutrient Uptake

Maximum daily uptake rates for Ca and Mg occurred at 58 to 98 days after planting (first to fourth week of bloom) which was close to the period of maximum dry matter production. The maximum accumulation period for S was different since S uptake reached a peak during the last sampling interval. Peak uptake rates ranged from 1.4 to 2.1 lb/A/day for Ca, 0.3 to 0.7 lb/A/day for Mg and 0.3 to 0.4 lb/A/day for S. During the peak two-week intervals, an average of 48 percent of the total Ca, 39 percent of the total Mg and 30 percent of the total S was accumulated.

Summary

In this non-irrigated field study, four modern varieties of cotton accumulated similar amounts of Ca, Mg and S. The varieties tested were also similar in how Ca, Mg and S were distributed within the cotton plant and the rate that these nutrients were accumulated during the season. Levels of available Ca, Mg and S did not limit the growth of the cotton plants. Under these non-limiting conditions, an average of 7.6 lb of Ca, 2.1 lb of Mg and 2.4 lb of S was accumulated for every 100 lb of lint produced. ■