CHANGES IN COTTON PLANT GROWTH AND PHYSIOLOGY DURING THE DEVELOPMENT OF BORON DEFICIENCY

Duli Zhao and Derrick Oosterhuis
Department of Crop, Soil and Environmental Sciences
University of Arkansas
Fayetteville, AR

Abstract

Boron (B) has long been known as an essential micro nutrient element required for optimal development of cotton (*Gossypium hirsutum* L.) plants. Boron deficiency is common in highly leached and acidic sandy soils of cotton growing regions in the world. Because B is important in pollen germination and pollen tube growth for successful fruiting, B deficiency during flowering and fruiting may significantly reduce boll retention, resulting in low yield and poor fiber quality. A better understanding of the effect of B deficiency during early growth on subsequent reproductive growth and carbon metabolism of cotton plant can help us to manage boron application in high-yield cotton production. An experiment was conducted in controlling environmental growth chamber to determine the changes in plant growth, dry matter accumulation, leaf net photosynthesis, leaf chlorophyll content, and nonstructural carbohydrate concentrations in leaves and floral buds, and tissue B concentration during the development of B deficiency.

The results of our study indicated that B deficiency decreased plant height, main-stem node numbers, leaf area, and floral bud numbers. Under B deficiency, leaf carbon fixation and assimilate translocation were reduced significantly, resulting in an increase in leaf starch and a decrease in floral bud nonstructural carbohydrates. Decreased leaf net photosynthetic rate of B-deficit plants was associated with decreased stomatal conductance, lower cell membrane integrity, and build-up of starch. Boron deficiency increased fruit shedding and specific leaf weight, and decreased cotton plant dry matter (DM) accumulation and partitioning, with the greatest effect on fruit DM accumulation and the smallest effect on leaf DM accumulation.

Leaf B content was the most sensitive to B supply and changed considerably with leaf position in the plant canopy and with plant growth. Therefore, when collecting leaves for tissue B diagnosis, sampling time and leaf position must be considered because leaf B concentration increased with plant age and decreased with leaf position up the main stem. The critical B level of the uppermost main-stem leaf was about 17 ppm on a dry matter basis during squaring. This critical value may be used as an indicator of cotton B deficiency.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:540-540 (2001)
National Cotton Council, Memphis TN