ALTERATION OF COTTON SOURCE-SINK RELATIONS BY CROP MANAGEMENT PRACTICES

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Abstract

Improvements in carbohydrate (CHO) source-sink relations are needed to improve efficiency of yield formation in cotton. Breeding has improved partitioning to bolls, but vestiges of cotton's perennial background remain. Source-sink relations become increasingly unbalanced during boll filling, as older leaves become less capable of fulfilling demand by nearby bolls, and younger leaves atop the canopy are increasingly distant from rapidly filling bolls. Boll load carried to maturity is strongly influenced by CHOs, as new bolls are set only if the collective demand for CHOs does not exceed the supply. Storage carbohydrates in stem and root tissue appear to serve as a source-sink buffer, acting as sink when photosynthate supply exceeds demand, and vice versa. The main storage CHO in cotton vegetative tissue is starch. Starch levels vary appreciably within and between growing seasons, but it appears that cotton breeding efforts in the 20th century didn't alter starch dynamics appreciably. Crop management practices that might alter CHO source-sink relations include seeding rate (affecting plant population density, or PPD), and plant growth regulator (PGR) application. A 3-year field study in Tennessee tested the hypothesis that increasing PPD would reduce boll retention more than leaf area, thus increasing the leaf-to-boll ratio during boll fill, and increasing residual starch in vegetative storage. The PPD treatments ranged from 8.3 to 17.6 plants m^{-2}. Higher PPD tended to reduce boll load more than leaf area per plant. Boll distribution was more concentrated at higher PPD, creating more synchronous demand for photosynthate. However, stem starch concentrations were similar to, or slightly lower, at higher PPD. The experiment also tested the hypothesis that application of mepiquat chloride (MC) would reduce leaf area more than boll set, decreasing the leaf-to-boll ratio during boll fill, and decreasing vegetative starch reserves as bolls fill. The PGR treatments were 86 g ha^{-1} MC (total of 3 applications), and an untreated check (no MC). Application of MC tended to reduce leaf area per plant more than boll load. MC concentrated the boll set lower on the plant, increasing the synchrony of boll demand for photosynthate. MC increased boll set percentage and decreased residual stem starch reserves slightly. Results indicate that cotton source-sink relations can be altered by common cultural practices. Future research should quantify the contribution of vegetative CHO reserves to yield formation in cotton, and aim to improve it.