SUBSURFACE MICROIRRIGATION PLACEMENT EFFECTS ON COTTON LEAF N AND WATER POTENTIAL

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Abstract

Cotton production in much of the southeastern USA often benefits from supplemental irrigation. Many of the cotton fields in the region are small, irregular in shape, or contain rolling topography, which can make surface and sprinkler irrigation systems unfeasible. Microirrigation system configurations are more versatile and this may make them more adaptable, especially if costs can be reduced. Multiple low rate applications of water and crop nutrients are possible with microirrigation systems. Little information is available on optimal N management with these systems in the region. The objective of this research was to determine the effect of buried microirrigation tube spacing on plant N status and water status.

The experiment was conducted on a Eunola loamy sand (Typic Paleudult) soil near Florence, SC, in 1991 through 1994. The irrigation treatments were buried microirrigation tube under every row (38" spacing), in the center of alternate mid-rows (76" spacing), and rainfed. Nitrogen treatments were sidedress application of 100 lb/ac approximately one month after emergence (all N prebloom), 10 or 20 lb/ac applied as needed when GOSSYM-COMAX predicted N stress to occur within one week, and five weekly applications of 20 lb/ac beginning at one month after emergence. For the irrigated treatments, all three N application treatments were evaluated. For the rainfed plots, only the single sidedress application and the N application timing based on GOSSYM-COMAX were evaluated. All N applications were made via microirrigation tubing; tubing was placed on the surface next to the row in the rainfed plots for this purpose. All N was applied with 0.25" of water. Cotton ('Pee Dee 3') was seeded in mid-May each year.

Eight to ten uppermost fully expanded cotton leaves were collected from an interior row in all subplots at weekly intervals from mid- to late-June through August each year for leaf N and petiole nitrate-N determinations. Leaf water potential was determined for all three irrigation treatments but only in plots that received the 100 lb/ac sidedress application at prebloom. On cloud-free days, a pressure bomb was used to determine midday xylem pressure potentials of uppermost fully expanded leaves. Measurements were made between 1230 and 1330 EDT on two leaves in each plot.

During early bloom in 1991 and in late-August 1993, the rainfed cotton had higher petiole nitrate levels than either irrigated treatment. In 1994, the rainfed cotton had higher petiole NO_3-N levels than the alternate furrow irrigation tubing placement at the first two sampling dates, but in-row placement was similar to rainfed at those sampling times. Buried microirrigation tubing placement generally did not affect petiole NO_3-N levels of cotton leaves in any year.

The N application method X sampling date interaction was significant for petiole NO_3-N in each year of the study. In both 1991 and 1992, the treatment with all N applied prebloom was lower than the five weekly applications of 20 lb/ac treatment at some dates. The GOSSYM-COMAX treatment did not differ from either of the other two N application treatments at any sampling date in those years. In 1993 and 1994, the lower N application rate with the GOSSYM-COMAX treatment resulted in that treatment having lower petiole NO_3-N levels than the other two N application treatments at several sampling dates each year.

No differences were detected between the microirrigation tube placements for leaf blade N at any sampling date in any year of the study. As occurred for petiole NO_3-N, the rainfed cotton had higher leaf blade N levels in early-July 1991; otherwise differences between rainfed and irrigated cotton did not occur. The three N application method treatments had similar leaf blade N levels at all sampling dates in 1991, 1992, and 1993. Similar to our results for petiole NO_3-N, the GOSSYM-COMAX treatment had lower leaf blade N levels than the other two N application treatments in late-July and early-August 1994.

In 1991, 1992, and 1993, water deficit stress developed in the rainfed plots. Leaf water potential of the alternate furrow placement did not differ from the in-row placement at any time. In 1994, adequate precipitation occurred throughout the year, and no differences ($P \leq 0.10$) were detected between irrigated and rainfed plot at any sampling time.

Irrigation did not increase cotton lint yield in either 1991 or 1994. Lint yield of the irrigated cotton was 19% higher in 1992 and 62% higher 1993, but in neither year did tubing placement affect cotton yield. Nitrogen application did not impact yield in any year of the study. Since few in-season differences between alternate furrow and in-row placement of tubing occurred for leaf N and plant water status, a wider tubing spacing than in-row placement appears to be adequate for supplying both water and N to cotton on these soils.

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