

NARROW ROW CORN PRODUCTION WITH SUBSURFACE DRIP IRRIGATION

K. C. Stone, P. J. Bauer, W. J. Busscher, J. A. Millen

ABSTRACT. *In the southeastern U.S. Coastal Plains, supplemental irrigation is required to reduce the impact of short-term droughts and yield-reducing plant water stress that can occur at least biennially. Sprinkler irrigation is commonly used to water agronomic crops in the region. Microirrigation is typically used for high value fruit and vegetable crops. In recent years and at some locations, microirrigation combined with conservation tillage has been implemented for agronomic crop production to help conserve soil moisture. In this research, we investigated the feasibility of planting corn (Zea Mays L) in narrow rows over subsurface drip irrigation (SDI). Our specific objectives were to 1) compare narrow-row corn yields using surface and subsurface drip irrigation with laterals spaced at 1 and 2 m; 2) compare the effects of pulsed SDI applications to move irrigation water farther away from the laterals on narrow-row corn yields; and 3) evaluate the impact of corn row distance from SDI laterals on plant biomass, nitrogen, and yield components. Corn was planted in 0.38-m rows on an existing subsurface drip irrigation system with laterals installed 0.30 m below the soil surface and spaced at 1 and 2 m apart. Surface drip irrigation was installed at both lateral spacings to compare with the SDI treatments. Irrigation was applied weekly as required to meet the crop water demands. All nutrients were applied through the subsurface drip irrigation system. Corn yields for 2003 ranged from 4301 to 5420 kg/ha, while in 2004 the yields were greater and ranged from 4452 to 6329 kg/ha. No significant differences were observed between the SDI and surface drip irrigated treatments. Corn yields from the pulsed SDI treatments were not significantly different from non-pulsed treatments. Early season whole plant biomass was significantly higher for the 2-m SDI lateral spacing, but there were no significant biomass differences at later growth stages. Corresponding whole plant N concentrations were significantly higher for the 1-m SDI lateral spacing in 2004. Grain N, ear length, and ear weight were not significantly different at harvest for SDI lateral spacing. We found that the distance of the corn rows from the SDI lateral greatly influenced the crop growth and grain yield. Plant biomass, whole plant N, ear length, and grain weight all decreased significantly with distance from the SDI laterals. These results show a great deal of variability among rows when corn is grown in 0.38-m spacing over SDI laterals for wider row crops. Higher plant populations placed closer to the laterals may increase productivity.*

Keywords. *Subsurface drip irrigation, Narrow-row corn production, Water conservation.*

In the southeastern U.S. Coastal Plains, the average annual precipitation is nearly equal to the annual evapotranspiration (ET). However, growing seasonal rainfall is usually not sufficient to satisfy crop ET requirements. Sheridan et al. (1979) reported that crop yields were reduced by drought stress at least one out of two years in the southeastern U.S. Coastal Plain. Growing seasons typically have short drought periods (5-20 days). Combined with the region's coarse-textured soils and low water storage capacity, these short-term droughts result in yield-reducing plant water stress.

Supplemental irrigation is used to reduce the impact of these short-term droughts. Sprinkler irrigation is the most common form of watering agronomic crops in the region, while microirrigation is typically used for higher value crops

such as vegetables and fruits (USDA-NASS, 2003). Camp et al. (1995) reported on a series of studies on the feasibility of microirrigation for row crops in the southeastern Coastal Plain of South Carolina. They reported nine site-year results for corn, soybean, and cotton and found little difference between surface and subsurface drip irrigation at lateral spacing from 0.76 to 2.0 m. Camp et al. (1997) also investigated cotton and peanut production using 30-cm-deep subsurface drip irrigation (SDI) with laterals installed at 1- and 2-m widths (every row and alternate furrows, respectively). They found significant yield increases over rain-fed plots in two of four study years. In a review of SDI systems, Camp (1998) reported lateral spacing ranging from 0.25 to 5.0 m, with narrow spacing used primarily for turfgrass and wide spacing often used for vegetable, tree, or vine crops on beds. The SDI lateral spacing is usually determined by soil type and crop rooting characteristics. Generally, SDI lateral spacing is usually located under each row or between alternative rows. In the southeastern United States, SDI systems are usually installed with laterals spaced 1 m or greater distances for high value crops (Camp, 1998). Increased interest in SDI use with agronomic production is influenced by efforts to more efficiently utilize water resources of the region that are coming under increasing competition by urban and industrial demands.

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The authors are **Kenneth C. Stone**, ASABE Member Engineer, Agricultural Engineer, **Philip J. Bauer**, Agronomist, **Warren J. Busscher**, Soil Scientist, and **Joseph A. Millen**, ASABE Member Engineer, Agricultural Engineer, USDA-ARS Coastal Plains Soil, Water, and Plant Research Center, Florence, South Carolina. **Corresponding author:** Kenneth C. Stone, 2611 West Lucas St. Florence, SC 29501; phone: 843-669-5203; fax: 843-669-6970; e-mail: ken.stone@ars.usda.gov.

In Virginia, Powell and Wright (1993) evaluated corn yields on a loamy sand soil using SDI spacings of 0.91, 1.83, and 2.74 m. They found that additional irrigation was required for the wider lateral spacing to obtain corn yields comparable to the narrow lateral spacings. The highest observed yields were from the narrow SDI laterals that were under each corn row. They found decreasing corn yields with increased distance from the SDI lateral.

In recent years, the combined use of conservation tillage systems with drip irrigation has increased. Conservation tillage reduces soil water evaporation until canopy cover can be reached; reducing soil water evaporation is part of the reasoning for installing SDI systems. Using SDI with conservation tillage, Camp et al. (1999) investigated a wheat-soybean-cotton rotation under conservation tillage and found similar yields as those for a rain-fed system. They concluded that a shallow compacted zone in these soils at about the same depth as the SDI tubing limited root growth and reduced the effect of irrigation.

Lamm et al. (1997) used conservation tillage in a study to determine optimum SDI lateral spacing for corn in western Kansas. They studied lateral spacings from 1.5 to 3.0 m and found that the wider lateral spacing resulted in nonuniform soil water distribution and decreased yields with distance from the lateral.

Recent research has indicated that conservation tillage combined with narrow-row (< 0.5 m) crop production has the potential to improve productivity on southeastern Coastal Plain soils (Bauer et al., 2002). The combination of narrow-row widths with no surface tillage and intensive deep tillage resulted in higher yields when compared to conventional row widths for both corn (Bauer et al., 2002) and soybean (Frederick et al., 1998). They reported that an increasing number of growers are considering narrow-row systems in efforts to improve their profitability.

To address the increasing interest in narrow-row corn production in combination with the need for supplemental irrigation in the southeastern United States, we initiated a study to investigate the potential of growing narrow-row corn in fields that have existing subsurface drip irrigation systems.

The overall objective of the study was to determine the feasibility of narrow-row corn (38 cm) production on an existing subsurface drip irrigation system with laterals spaced at 1.0 and 2.0 m. The specific objectives were to 1) compare narrow-row corn yields using surface and subsurface drip irrigation with laterals spaced at 1.0 and 2.0 m; 2) compare the effects of pulsed SDI applications to move irrigation water farther away from the laterals on narrow-row corn yields; and 3) evaluate the impact of corn row distance from SDI laterals on plant biomass, nitrogen, and yield components.

METHODS AND MATERIALS

The experiment was conducted at the Clemson University's Pee Dee Research and Education Center near Florence, South Carolina, on a 1.2-ha site of Eunola loamy sand (Aquic Hapludults) soil in 2003 and 2004. The subsurface drip irrigation system (SDI) used in the experiment was installed in 1991 and described previously by Camp et al. (1997 and 1999). The irrigation system consisted of individual polyvinylchloride (PVC) pipe manifolds (supply and discharge) for

each subplot. Each discharge manifold had removable end caps for flushing. Irrigation laterals (GEOFLOW ROOT-GUARD[®]) had in-line, labyrinth emitters spaced 0.6 m apart, each delivering 1.9 L/h at 140-kPa pressure. Laterals were installed 0.30 m deep using two modified subsoiler shanks mounted on a tool bar. Water was supplied from a well and filtered via a 100-mesh cartridge filter. All irrigation applications were monitored and controlled by a programmable microprocessor-based irrigation controller. A single solenoid valve controlled water applications to all plots for each irrigation treatment. Pressure was regulated at about 140 kPa using in-line pressure regulators in the supply manifold for individual plots. The SDI laterals were installed on 1- and 2-m spacings. The SDI site was originally designed for cotton and peanuts planted on 1-m rows. Control plots (rain-fed) consisted of non-irrigated plots; these plots had surface drip irrigation laterals (at both 1- and 2-m spacings) that were only used for fertigation. Additionally, to compare SDI with surface drip irrigation, we installed surface drip irrigation laterals at both spacings. Individual plots were 15 m long and 8 m wide.

Irrigation scheduling was on a weekly basis using estimated crop water requirements from Rhoads and Yonts (1991). Irrigation applications were scheduled two times per week (Monday and Thursday). Irrigation depth for each application was half the weekly water requirements. If rainfall occurred before the weekly scheduled irrigations, the irrigation depth was calculated by subtracting rainfall from the total weekly water requirements.

In both 2003 and 2004, corn (Pioneer 32K64) was planted (20 May 2003 and 5 April 2004) in 0.38-m rows using a no-till planter through the plot centers at populations of approximately 7.8 plants/m² (fig. 1). In 2003, corn was double cropped following a flax winter cover crop. The corn was harvested on 20-21 October 2003 and on 25 August 2004 using a combine and each plot was weighed individually.

Fertilizer was applied to all corn plots via the drip irrigation system in 5 mm of water. Fertilizer was applied in two applications of 28-0-0-4% UAN (urea and ammonium nitrate) with sulfur to all plots through the irrigation system with 67 kg N ha⁻¹ on 12 June 2003 and 20 April 2004 and with 135 kg N ha⁻¹ on 30 June 2003 and 20 May 2004. Fertilizer applications were applied in approximately 5 mm of irrigation water to all plots.

Gauge type tensiometers (Soilmoisture Equipment Corp., Goleta, Calif.) were installed for all treatments in replication 2 in the corn rows at depths of 0.3 and 0.6 m at the mid-point between the surface SDI laterals and in the center row for the control (rain-fed) plot. Tensiometers were serviced as required and readings were recorded two times per week. Weather data were obtained from a weather station located adjacent to the experimental area (NRCS Scan weather station, <http://www.wcc.nrcs.usda.gov/scan/site.pl?site-num=2037&state=sc>).

TREATMENTS

The experimental design was a randomized complete block (fig. 2) with four replications. The experiment consisted of 10 total treatments conducted for both yield (treatments 1-10 with four replications) and biomass determination (treatments 1-6 with four replications). Table 1 and figure 2 show details of the treatment numbers and experimental layout. Three SDI treatments were conducted at each

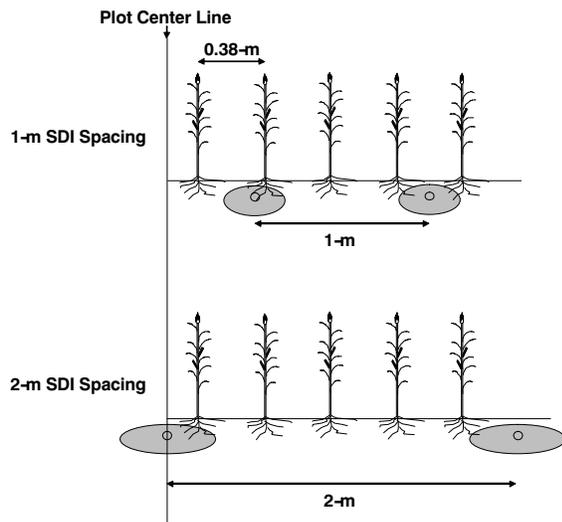


Figure 1. Planting pattern for narrow-row corn over existing SDI laterals.

lateral spacing. For each SDI lateral spacing, water was applied in one, two, or three pulses. Pulse SDI treatments were included in this experiment to investigate whether pulsed applications distribute water farther away from the laterals than continuous application. In the one pulse treatment, irrigation water was applied in one continuous application. In the two-pulse treatment, irrigation water was applied in two equal applications 12 h apart. For the three-pulse treatment, irrigation water was applied in three equal applications 8 h apart. Total irrigation water applied was equal for all treatments. A surface drip irrigation treatment was included to compare with the SDI treatments at each lateral spacing. Irrigation for the surface drip treatments was applied in one continuous application. Control plot (rain-fed) treatments received no irrigation.

Plant biomass and whole plant N measurements (above ground) were collected from the growing corn crop two times

during the growing season (sixth leaf stage and at silk emergence) from the SDI treatments. At each growth stage, all plants in 2 m of row were collected from each of five interior rows of each biomass plot (fig. 1). Biomass sampling locations for the sixth leaf stage were selected randomly along the center line of the plot. The second biomass sampling location at silk emergence was selected randomly from an area of the individual plot not influenced by the first biomass sampling. Samples were dried at 60°C and weighed. Sub-samples of the plant material were ground, and N concentrations in the plant tissues were determined with a LECO Carbon/Nitrogen Analyzer (Model CN2000, LECO, St. Joseph, Mich.).

At harvest, five ears were collected from each of the five rows sampled for biomass. Ear length, grain weight per ear, and grain N were determined. Our original intent was to collect the ears from five consecutive plants. However, in some rows (especially those farthest from the laterals), there were quite a few barren plants. Therefore, five ears were collected randomly throughout each row. Thus, grain production in those rows may be overestimated.

Table 1. Experimental treatments for the subsurface drip irrigation experiment.

Treatment No.	Lateral Width (m)	No. of Pulses	Replications (Yield)	Replications (Biomass)	SDI or Surface
1	1	1	4	4	SDI
2	1	2	4	4	SDI
3	1	3	4	4	SDI
4	2	1	4	4	SDI
5	2	2	4	4	SDI
6	2	3	4	4	SDI
7	1	1	4	-	Surface
8	2	1	4	-	Surface
9	1	0	4	-	Non-irrigated
10	2	0	4	-	Non-irrigated

Subsurface Drip Irrigation Plot Layout

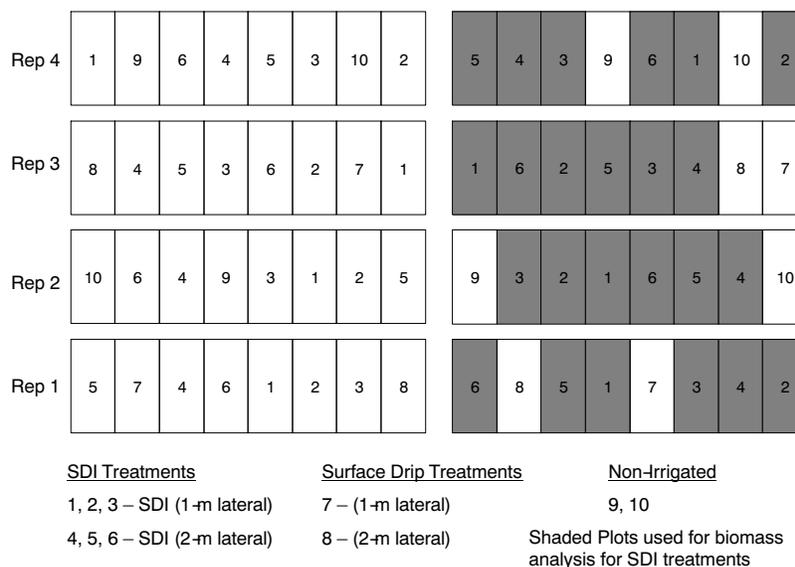


Figure 2. Subsurface drip irrigation plot layout and randomization.

STATISTICAL ANALYSES

The data were analyzed using the SAS System (SAS, 2002) and were subject to analysis of variance (ANOVA). The yield data were analyzed by year, and the treatment interactions were partitioned with single degree of freedom contrasts. With contrasts, we compared (1) surface drip irrigation versus rain-fed, (2) SDI versus surface drip irrigated, (3) SDI versus rain-fed, (4) 1-m versus 2-m SDI irrigation lateral spacing, (5) 1-m versus 2-m surface drip irrigation lateral spacing, (6) irrigated versus rain-fed, (7) one pulse SDI versus multiple pulse SDI, (8) one pulse SDI versus one pulse surface drip, and (9) the interaction between lateral depth (surface drip and SDI) and lateral spacing placement (1 and 2 m).

For the plant biomass, N, ear length, and grain weights, we analyzed the data for only the SDI plots and used an ANOVA to analyze for significant differences among SDI lateral spacings. These samples were also analyzed using a regression analysis to determine the impact of the distance from the SDI lateral for both lateral spacings.

RESULTS

In 2003, the cumulative total water applied was 64.5 cm compared with 72.9 cm in 2004 (figs. 3 and 4). The cumulative effective rainfall for the 2003 and 2004 growing seasons was 34 and 43 cm, respectively. In both 2003 and 2004, the total applied water slightly exceeded calculated crop requirements. For most weeks, the crop requirements needed supplemental irrigation water, particularly during the later parts of the growing season.

Soil water potentials were measured throughout the season at the mid-points between the SDI lateral. Soil water potentials had similarities for the SDI lateral spacings during both years (figs. 5 and 6). In 2003, the soil water potentials for the 2-m spacing were higher in the early season, but were similar to the 1-m spacing the remainder of the growing season; this was observed for both the 0.3- (fig. 5) and 0.6-m (not shown) tensiometer readings. In 2004, both lateral spacings had similar patterns in soil water potentials for the two tensiometer depths. Non-irrigated treatments had higher soil water potential throughout both growing seasons.

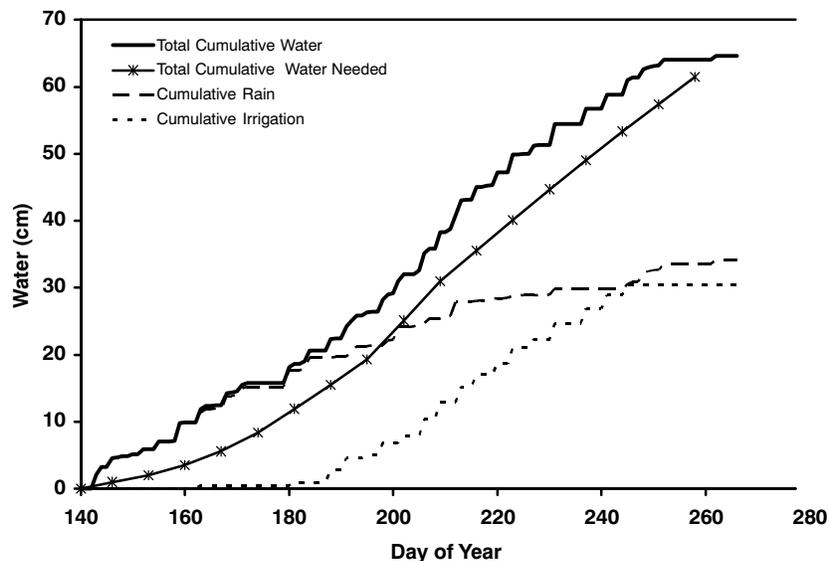


Figure 3. Cumulative water application for 2003 SDI narrow-row corn.

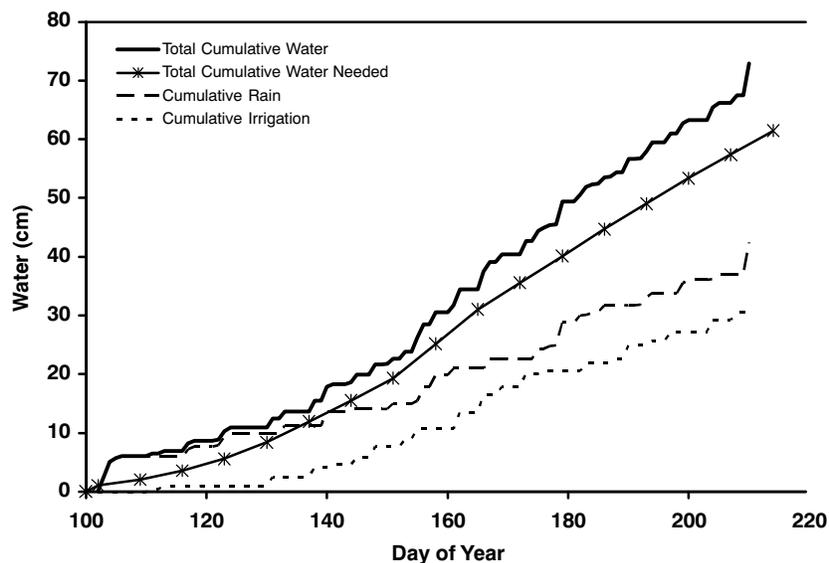


Figure 4. Cumulative water application for 2004 SDI narrow-row corn.

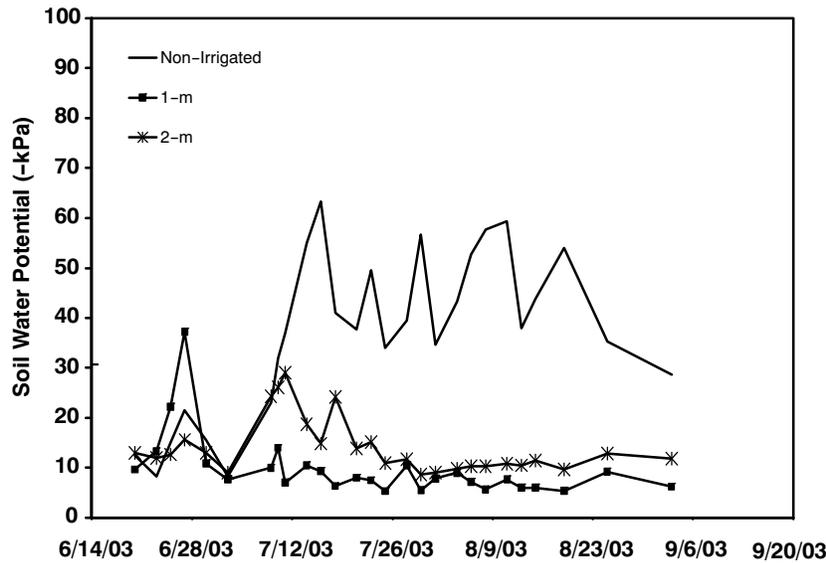


Figure 5. Soil water potential at a depth of 0.3 m for the 1-m, 2-m SDI, and non-irrigated narrow-row corn in 2003.

In both 2003 and 2004, irrigation applications were applied in one, two, or three pulses. In 2003, there were some initial differences in soil water potential among the pulsed applications (data not shown). Typically, the one pulse application would have slightly lower soil water potential than the two- and three-pulse applications. After the first month, the soil water potentials were similar among all pulsed treatments. In 2004, similar patterns of soil water potential among the pulsed treatments were also observed. It appears that for this soil, the pulsing had minimal effect on the soil water potential. On heavier textured soils, the pulsing application may improve the lateral distribution of water away from the SDI laterals; but for coarse textured soils in this study pulsing did not improve lateral water distribution. Camp et. al. (1993) found no differences for multiple pulses for several vegetable and fruit crops. Elmaloglou and Diamantopoulos (2007) found more vertical water movement for surface pulsed applications being used vs. continuous applications.

CORN YIELDS

The overall corn yields for 2003 and 2004 were 5093.2 and 5542.9 kg/ha, respectively (table 2). Mean corn yields and mean square errors from the single-degree of freedom contrasts for the two-year study are shown in tables 2 and 3, respectively. The corn yields in 2003 were lower on average and ranged from 4301 to 5420 kg/ha while in 2004 the yields were greater and ranged from 4452 to 6329 kg/ha.

In 2003, corn yields were not significantly different for rain-fed, surface, or subsurface drip irrigation. The interaction between SDI and surface drip irrigation with lateral spacing (contrast 9, table 3) was the only treatment with a significant difference in 2003. This significant interaction appears to be influenced by low corn yields for the 2-m surface drip irrigation treatment.

In 2004, corn yields for the SDI 1-m lateral spacing were significantly greater than the 2-m SDI treatments. In both years, neither irrigation method (surface or SDI) was significantly different from the rain-fed treatments. The lack

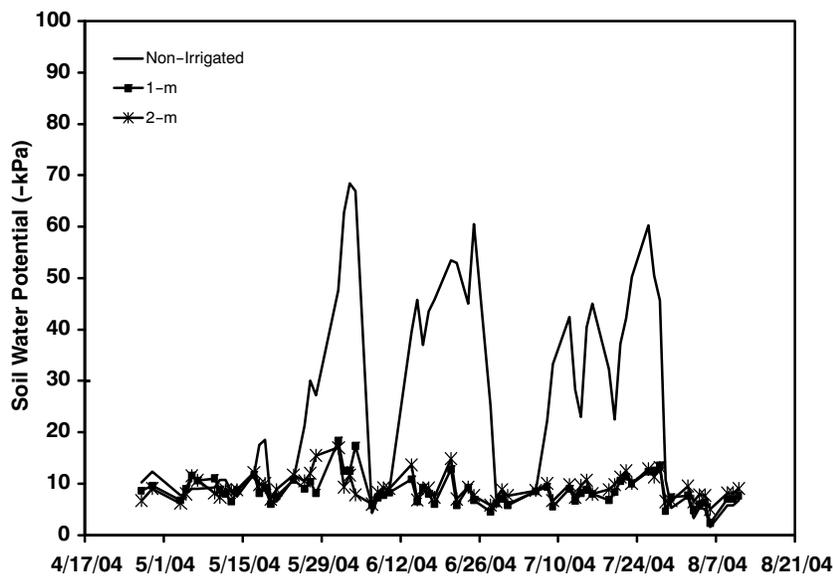


Figure 6. Soil water potential at a depth of 0.3 m for the 1-m, 2-m SDI, and non-irrigated narrow-row corn in 2004.

of difference in yields across irrigation treatments was partially explained by the similarity of the measured soil water potentials that were consistently below the threshold (-30 kPa) that would typically be utilized to initiate irrigation at this site.

SDI LATERAL SPACING IMPACTS ON BIOMASS, NITROGEN, AND YIELD

The early season whole plant biomass was significantly higher for the 2-m spaced SDI laterals in 2003. In 2004, there was no significant difference in the early season whole plant

biomass (table 4). At silking stage, there were no significant differences for either 2003 or 2004. The biomass samples were also analyzed for total combustible nitrogen. In 2003, neither the early or silking stages of the whole plant N concentrations were significantly different for the two SDI lateral widths. In 2004, the 1-m SDI lateral spacing for the whole plant N was significantly higher than the 2-m SDI laterals for both growth stages.

At harvest, we analyzed both SDI lateral widths for grain N, ear length, and ear weight (table 5). In both years, the corn ear lengths were very similar and were not significantly

Table 2. Narrow-row corn yields (mean and standard deviation) using surface and subsurface drip irrigation and rain-fed treatments.

Lateral Width (m)	Pulse	Treatment Number	Corn Yield (kg/ha)		
			2003	2004	Both Years
SDI					
1	1	1	5182.1 ± 610.8 ab ^[a]	6193.4 ± 241.5 a	5687.8 ± 690.7
1	2	2	5303.6 ± 987.1 ab	6328.5 ± 645.2 a	5816.1 ± 946.7
1	3	3	5157.5 ± 778.5 ab	5893.1 ± 282 abc	5525.3 ± 669.6
2	1	4	5149.9 ± 797.9 abc	5015.8 ± 1129 cd	5082.8 ± 907.9
2	2	5	5420.1 ± 162.2 a	5044.4 ± 844 cd	5232.3 ± 597.4
2	3	6	5330.4 ± 698.5 ab	5521.2 ± 832 abc	5425.8 ± 718.4
Surface Drip					
1	1	7	5154.1 ± 523.3 abc	5974.1 ± 712.9 ab	5564.1 ± 726.2
2	1	8	4555.7 ± 839.8 bc	5792.9 ± 510.7 abc	5174.3 ± 922.7
Non-Irrigated					
1		9	5377.4 ± 323 ab	5212.8 ± 758.9 bcd	5295.1 ± 547.1
2		10	4301 ± 936.4 c	4451.6 ± 1414.2 d	4376.3 ± 1113.3
Overall			5093.2 ± 717.7	5542.9 ± 915.5	5318 ± 848.1
LSD _{0.05}			854.3	889.2	

^[a] Column means followed by the same letter are not significantly different at the P = 0.05 level.

Table 3. Mean square errors from the contrast analysis of variance for narrow-row corn yields.

Contrast	2003			2004			
	Mean Square			Mean Square			
	Error	F Value	Pr > F	Error	F Value	Pr > F	
1	Surface drip vs. rain-fed	487226	1.43	0.24	16503	0.04	0.83
2	SDI vs. surface drip irrigated	396684	1.16	0.29	95617	0.26	0.62
3	SDI vs. rain-fed	127673	0.37	0.55	16267	0.04	0.84
4	1- vs. 2-m SDI irrigation	44083	0.13	0.72	5353185	14.48	0.00
5	1- vs. 2-m surface drip irrigation	715987	2.10	0.16	65650	0.18	0.68
6	Irrigated vs. rain-fed	249402	0.73	0.40	2375	0.01	0.94
7	One pulse SDI vs. multiple pulse SDI	99952	0.29	0.59	45316	0.12	0.73
8	One pulse SDI vs. one pulse surface drip	496636	1.46	0.24	138218	0.37	0.55
9	Interaction between lateral depth (surface drip or SDI) and lateral spacing (1 and 2 m)	2025786	5.94	0.02	50396	0.14	0.72

Table 4. Biomass and whole plant nitrogen (mean and standard deviation) for the 1- and 2-m subsurface drip irrigation row widths.

SDI Lateral Width	Early Biomass (g/m ²)		Silk Emergence Biomass (g/m ²)		Early Whole Plant N (g/kg)		Silk Emergence Whole Plant N (g/kg)	
	2003	2004	2003	2004	2003	2004	2003	2004
1 m	34.8 ± 14.7	39.5 ± 12.7	1031.2 ± 387.8	724.9 ± 215.4	3.45 ± 0.47	2.95 ± 0.26	1.12 ± 0.17	1.42 ± 0.21
2 m	44.1 ± 17.3	38.8 ± 15.0	1122.0 ± 373.9	666.9 ± 235.2	3.54 ± 0.38	2.85 ± 0.28	1.13 ± 0.21	1.35 ± 0.24
LSD _{0.05} ^[a]	5.3*	4.14	127.1	61.6	0.14	0.085*	0.06	0.07*

^[a] LSD_{0.05} values followed by a * were significantly different at the P = 0.05 level.

Table 5. Grain nitrogen, ear length, and ear weight (mean and standard deviation) for the 1- and 2-m subsurface drip irrigation row widths.

SDI Lateral Width	Grain N (g/kg)		Ear Length (cm)		Ear Weight (g)	
	2003	2004	2003	2004	2003	2004
1 m	1.22 ± 0.10	1.08 ± 0.11	14.89 ± 1.85	15.09 ± 1.90	98.6 ± 25.5	110.7 ± 29.3
2 m	1.20 ± 0.08	1.08 ± 0.12	15.10 ± 1.98	14.61 ± 2.78	101.1 ± 25.9	107.8 ± 35.1
LSD _{0.05} ^[a]	0.03	0.04	0.45	0.69	5.83	9.42

[a] LSD_{0.05} values followed by a * were significantly different at the P = 0.05 level.

different over the two SDI spacings. The ear weights were higher in 2004 than in 2003, possibly due to the 2004 earlier planting date. There were no significant differences among the SDI lateral spacings for ear weight. The grain N was higher in 2003 than 2004, but in neither year were there significant differences between the two lateral spacings.

DISTANCE FROM SDI LATERAL IMPACTS ON BIOMASS, NITROGEN, AND YIELD

The biomass analyses for the early and silking stages were analyzed in relation to the distance from the SDI lateral (figs. 7 and 8). Data for both years were combined, and a regression analysis of biomass versus distance was performed on the means for each distance from the nearest SDI lateral (fig. 1). For the 1-m SDI lateral spacing, the biomass for both plant growth stages was best described

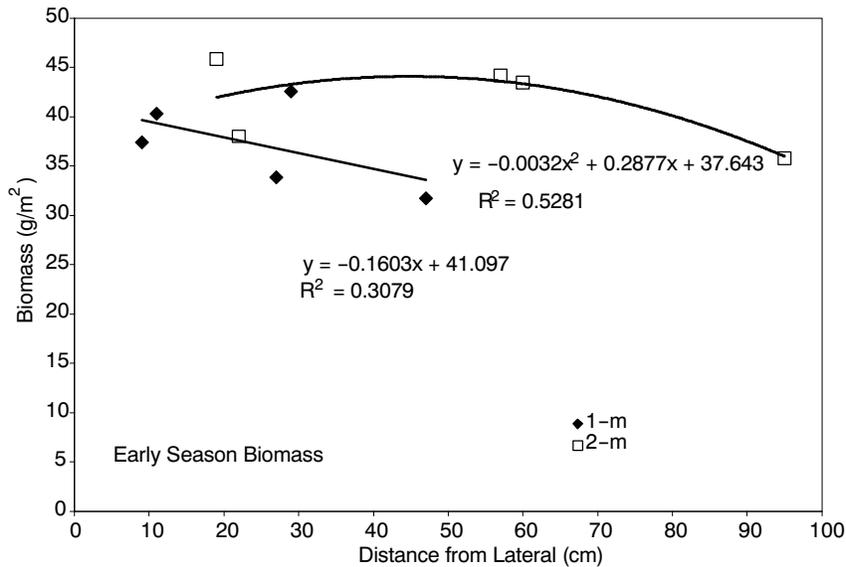


Figure 7. Early season biomass at the sixth leaf stage vs. distance from the subsurface drip irrigation lateral.

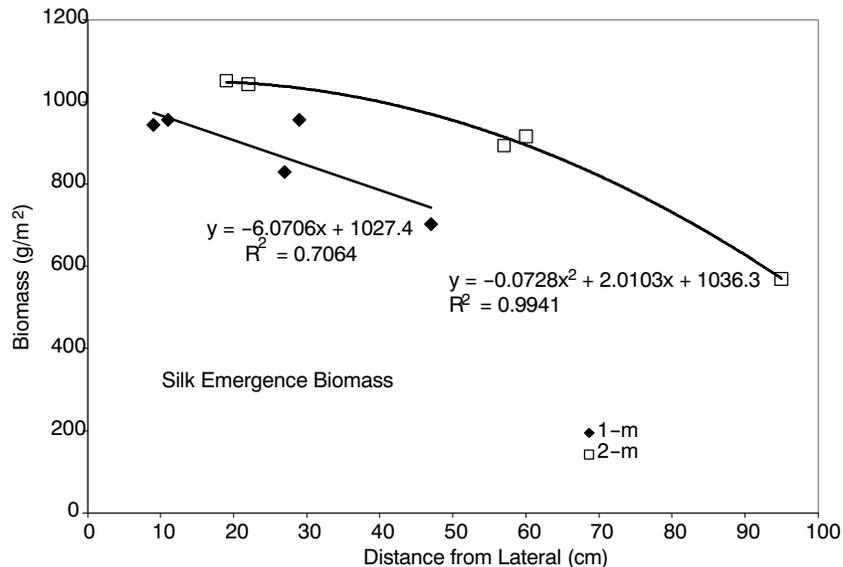


Figure 8. Biomass at silking emergence vs. distance from the subsurface drip irrigation lateral.

using linear regression. Both show a decrease of biomass as the distance from the SDI lateral increases. The 2-m SDI lateral spacing for both biomass samplings was best described using a quadratic regression. At the silking stage, the biomass dropped more rapidly than during the early biomass stage at the greater distances from the lateral.

Whole plant N regressions followed similar trends as those for the biomass regressions (figs. 9 and 10). Linear regression fit the early season whole plant nitrogen while a quadratic regression fit the 2-m SDI lateral spacing. For the silking stage whole plant N regression, both SDI lateral spacings followed a linear trend. The grain N analyses for both 1- and 2-m SDI laterals had slopes that were not significantly different from zero, indicating that there were no differences in grain N with distance from the lateral (data not shown).

For both SDI lateral spacings, the ear lengths decreased linearly with distance from the SDI lateral (fig. 11). The

slopes for both regressions were very similar, indicating a consistent decrease with distance from the SDI lateral. The ear weights also decreased linearly with distance from the SDI laterals (fig. 12). The 2-m lateral spacing had a higher slope, indicating a greater decrease in ear weight with distance from the SDI lateral. Ear length and weight results were similar to the normalized corn grain yields for those observed by Powell and Wright (1993). In a 4-year study, they found decreasing corn yields with increasing distance from the SDI laterals. They observed a more pronounced decrease in a dry year. In a study in Kansas, Lamm et al. (1997) observed large yield reductions or crop failure in rows farthest from the SDI laterals.

Analyses for both ear weight and length indicate that it may not be practical or economical to plant narrow-row corn over wider spaced (1-m) SDI laterals. Unfortunately, we were not able to include a treatment to compare narrow spaced SDI laterals (<1 m) with the wider lateral spacings (≥1 m).

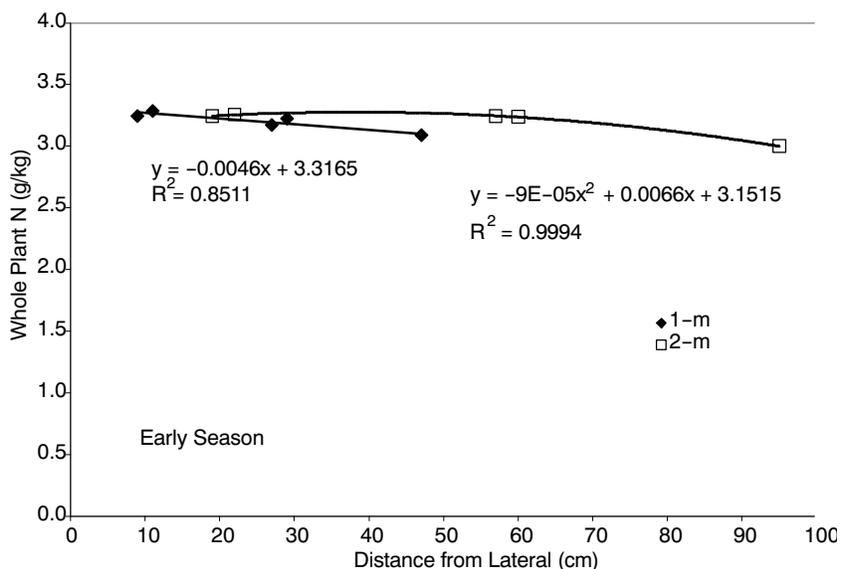


Figure 9. Whole plant nitrogen at the sixth leaf stage vs. distance from the subsurface drip irrigation lateral.

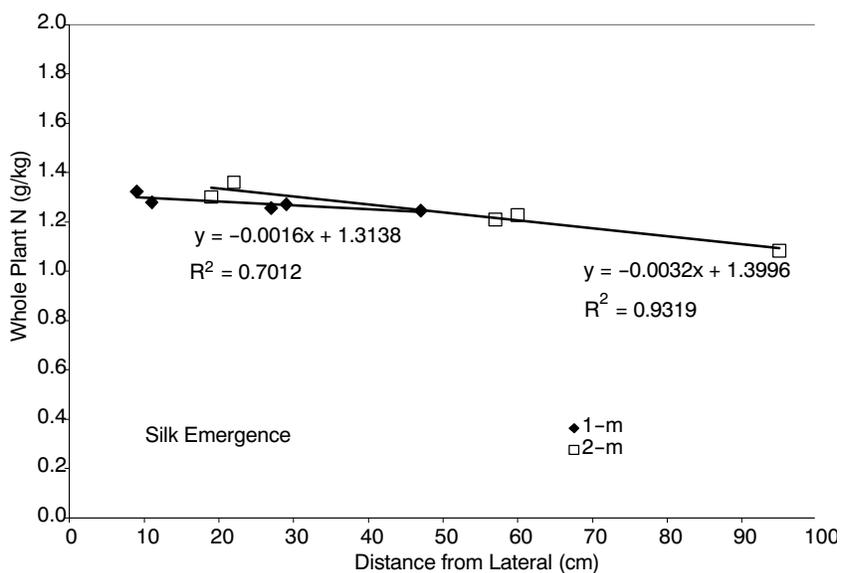


Figure 10. Whole plant nitrogen at silking emergence vs. distance from the subsurface drip irrigation lateral.

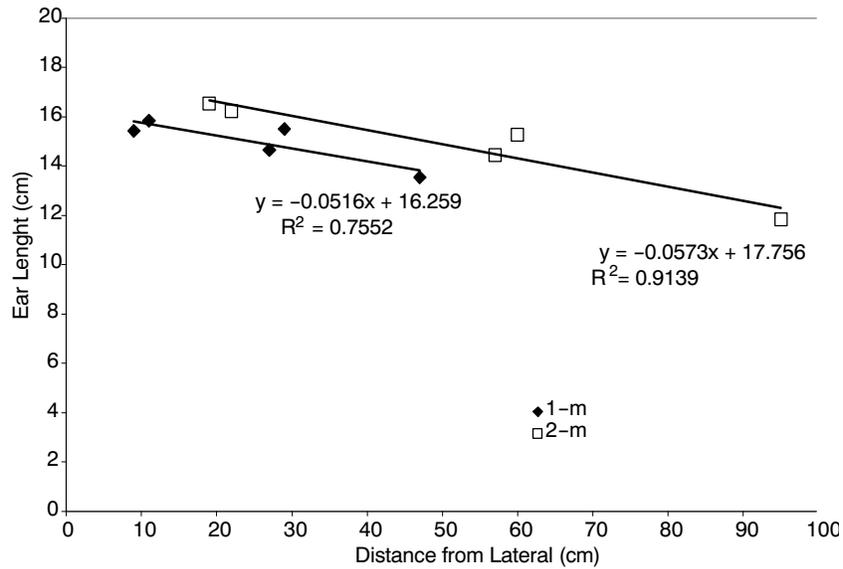


Figure 11. Ear length at harvest vs. distance from the subsurface drip irrigation lateral.

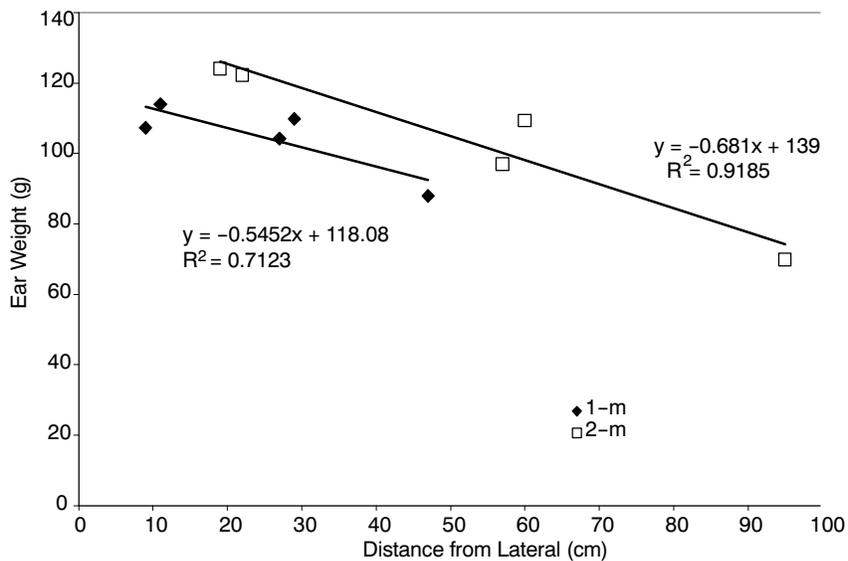


Figure 12. Ear weight at harvest vs. distance from the subsurface drip irrigation lateral.

SUMMARY AND CONCLUSIONS

An experiment was conducted to determine the feasibility of producing corn planted in narrow rows (0.38 m) over an existing subsurface drip irrigation system (SDI) with laterals spaced 1 and 2 m apart. Irrigation and nutrients were applied through the SDI system to meet crop and nutrient requirements. Irrigation water applied through the SDI system in one, two, or three pulses had similar soil water potentials and corn yields for both years, indicating that for this site, pulsed applications were not effective. For both years, the corn yields for the SDI irrigation treatments were not significantly different from the rain-fed treatments.

For the two SDI lateral spacings (1 and 2 m), the 2003 early season biomass was significantly higher for the 2-m spacing; however, at silk emergence, there were no significant biomass differences for either 2003 or 2004. In 2004, the

whole plant N taken at both growth stages had significantly higher concentrations for the 1-m SDI lateral spacing. At harvest, the ear length, weight, and grain N were not significantly different for either lateral spacing.

A regression was analyzed for the corn crop using the distance of the corn rows from the SDI laterals. For both growth stages analyzed, the biomass decreased as the distance from the SDI lateral increased. The whole plant N at both growth stages had small concentration decreases with increasing distance from the SDI laterals. The corn ear length and ear weights decreased significantly with increasing distance from the SDI laterals. These results show a great deal of variability among rows when corn is grown in 38-cm spacing over SDI laterals for wide-row crops. Attempts to reduce this variability by pulsing water applications did not work. Higher plant populations placed closer to the laterals may increase productivity.

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