COMPARISON OF SUBSURFACE DRIP AND FURROW IRRIGATION OF COTTON ON VERY SANDY SOIL UNDER FUSARIUM-NEMATODE PRESSURE

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OBJECTIVES: To compare drip and furrow irrigation by measuring the emergence, plant growth characteristics, yield, rate of plant die-off, and water use of Acala cotton on very sandy soil with a great deal of pressure from nematodes and Fusarium wilt.

PROCEDURES: This experiment was started in the Spring of 1989 on a 0.4-ha plot of uniform loamy sand soil. The initial (main) treatments were Acala SJ-2 under (1) subsurface drip, (2) proper furrow irrigation, and (3) poor furrow irrigation. The experimental design was a randomized complete block of 3 treatments with 5 replications. The main treatments were split in 1990 into 4 cultivars: SJ-2, GC-510, N8577, and C4226 (now called Royale). Also in 1990, Telone II (a nematicide) was applied to main treatment #3, and proper irrigation was used. Each plot consisted of four 88-m rows of cotton, with a row spacing of 0.76-m. In the drip treatment, the dripperline was 15-mil T-Tape with outlets spaced every 0.3 m, each discharging 1.0 L/h. The dripperline was placed 0.20 m below grade in the plant row. The drip system was monitored with a flow meter and pressure gages. "Proper" furrow irrigation included a high initial inflow to the furrow and then a cut-back of flow just before the water reached the end of the furrow."Poor" irrigation consisted of a constant low inflow to the furrow, with the water reaching the end of the furrow at about the same time the inflow was turned off at the end of the set. Fertilizer was applied to the drip and furrow treatments through the water. Neutron probe readings of soil moisture were taken in the middle of every main plot; likewise tensiometers were located in every main plot. Leaf moisture potential was also measured periodically.

RESULTS: In 1989 the cotton was planted about a month late (May 5). By July 5, stunting due to nematodes was evident, and by August 2, plants began dying from Fusarium wilt. Inadvertently, the plot chosen had soil that was contaminated with both Fusarium wilt and nematodes, and to compound the problem, the variety of cotton chosen was very susceptible to wilt.

As can be seen in Table 1, both the furrow treatments had a little better early emergence than the drip treatment, but the difference disappears at about the fifth day after planting. Figure 1 shows that the plants in the drip treatment were 18 to 20 cm taller than plants in the furrow treatments in August (degree-days > 1356). Measurements of the areas damaged by Fusarium wilt were taken October 1, 1989. The percent of plot area damaged averaged 27.0, 0.4, and 1.8 % for treatments 1, 2, & 3 respectively. Fusarium wilt was much worse in the drip plots than in the furrow plots. Soil was sampled for nematodes, and a count of second-stage juvenile root-knot nematodes was taken in March of 1990, showing 5773 nematodes per liter of soil in the drip plots, and 2515 per liter in the furrow plots. Sandy soil that is kept moist seems to be an excellent environment for nematodes and Fusarium wilt.

In spite of the larger area of damage to drip compared to furrow by Fusarium in 1989, the yield from the drip treatment still exceeded that from the furrow treatment. The yields were 917, 642, and 636 Kg/ha for treatments 1, 2, an 3 respectively, with a CV of 14%, and an LSD(05) of 153 Kg/ha. The difference is highly significant. The poor result from the furrow treatment may be partially due to the leaching out of nutrients from the porous soil, but even more likely is the insidious nature of nematode damage. If the damage is due to nematodes alone (no Fusarium), the plants do not die and they may appear only slightly shorter than what one would expect on a sandy soil, but the stress can be extreme. Figure 1 shows that the nematode-Fusarium problem started late enough that we could get some fairly decent plant height measurements.

In 1989, one tensiometer was placed in each drip plot, located in the plant row, 11 cm horizontally from and 18 cm below an emitter. The time clock controller generally was set to apply the same amount of water daily for up to a week at a time. Figure 2 shows how the tensions changed relative to pan evaporation at our weather station whenever the daily application rate was too high or too low for the period of peak water use from mid-July to mid-August. It appears that the proper value of the pan coefficient at peak water use is about 82%, i.e., if 82% of the pan had been applied each day, the tensiometer readings would not have changed at all, indicating that the amount of water being applied was exactly the same as that being used by the plant.

It is fairly obvious in Table 2 that without Telone, SJ-2 plants were dying off rapidly in early 1990. And in general, without Telone, drip-irrigated SJ-2 did much worse that furrow-irrigated SJ-2. Dead-plant counts later on indicated that GC510 is not entirely resistant to wilt. The best yields were obtained, of course, where nematodes were controlled, and as seen in Table 3, Telone-treated SJ-2 did the best, with an average of 1620 Kg/ha (3.0 ba/ac), which is quite good for the sand streak in which it was planted. GC510 did not yield as well as SJ-2 in the Telone treatment, but it is well-known that GC510 is not as high-yielding as SJ-2 under no-wilt conditions. Another feature that may not be well-known is that N8577 is not completely resistant to nematodes, doing better under drip than furrow (both without Telone), but producing only 92 and 84% of the Telone treatment for drip and furrow respectively. Actually GC510, N8577, and C4226 all did better under drip irrigation than under furrow irrigation (both without Telone), but none yielding anywhere near the potential for the soil. Figure 3 shows again that drip-irrigated plants are taller than furrow-irrigated plants.

FUTURE PLANS: Vapam will be applied to treatments 1 & 3. The variety Acala Maxxa will be used for the entire plot.

Table 1. Seedling emergence, 1989 (percent).

Date=	8May	9May	10May	11May	12May	22May
Day=	3	4	5	6	7	17
Heat units=	58	75	81	81	83	162
Treatment number						
1	0	15	52	62	65	66
2	0	22	55	62	64	65
3	0	23	57	65	65	66
LSD(05)	ns	3.6	ns	ns	ns	ns
CV (%)		12.6	7.1	5.8	5.4	4.9

Table 2. Average dead plant count per plot, 1990.
(out of 744 seeds planted/plot)

May 11 Variety	Drip	Furrow	Telone
SJ-2	58.2	28.2	1.4
GC510	8.6	2.8	0.0
N8577	3.0	4.6	0.6
C4226	1.9	1.0	0.0
Additional dead plants found May 14.			
SJ-2	41.5	22.0	1.4
GC510	5.5	4.2	0.2
N8577	9.5	3.2	0.0
C4226	3.5	3.4	0.4

Table 3. 1990 yield, Kg/ha

Variety	Drip	Furrow	Telone
SJ-2	205	595	1686
GC510	778	474	1483
N8577	1466	1345	1601
C4226	885	628	1613

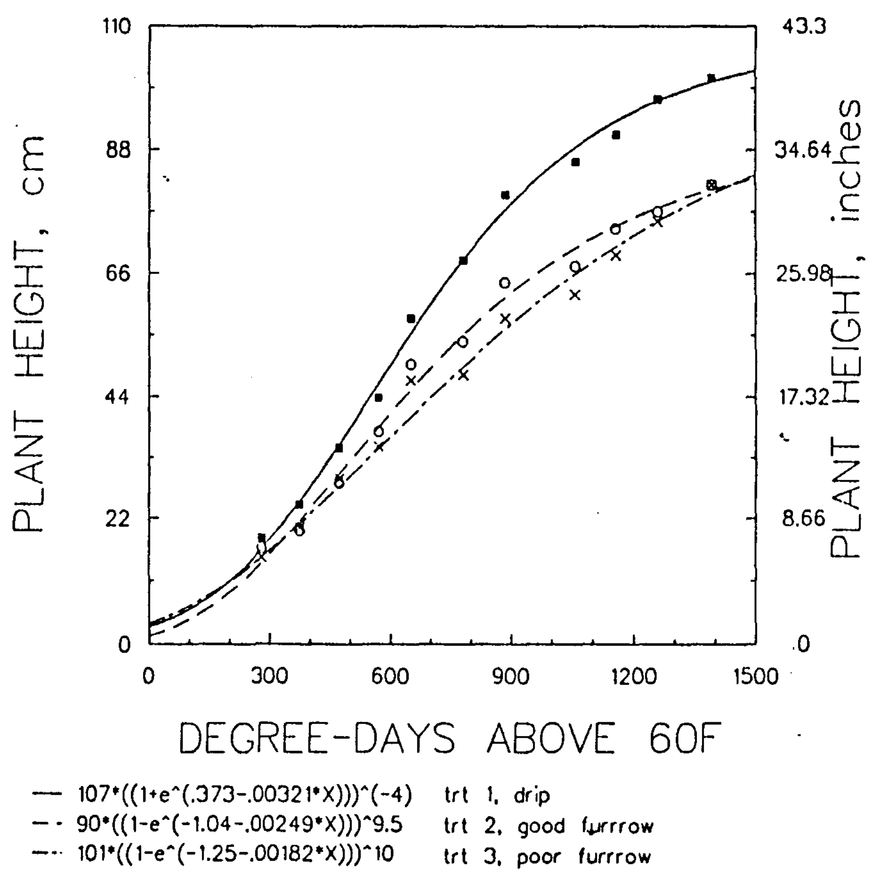

Figure 1. Plant heights, 1989

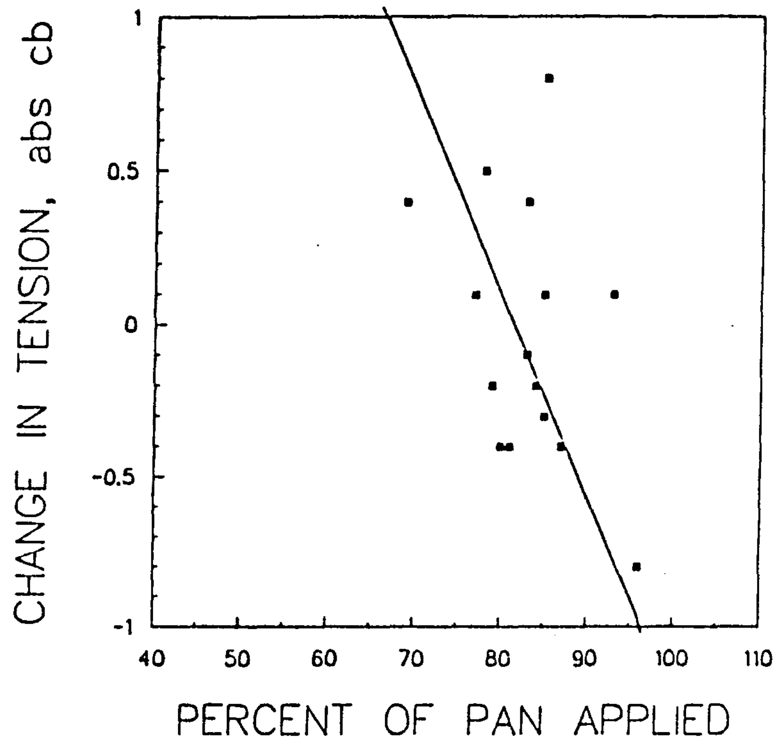

Figure 2. Tensiometer change vs pan evaporation

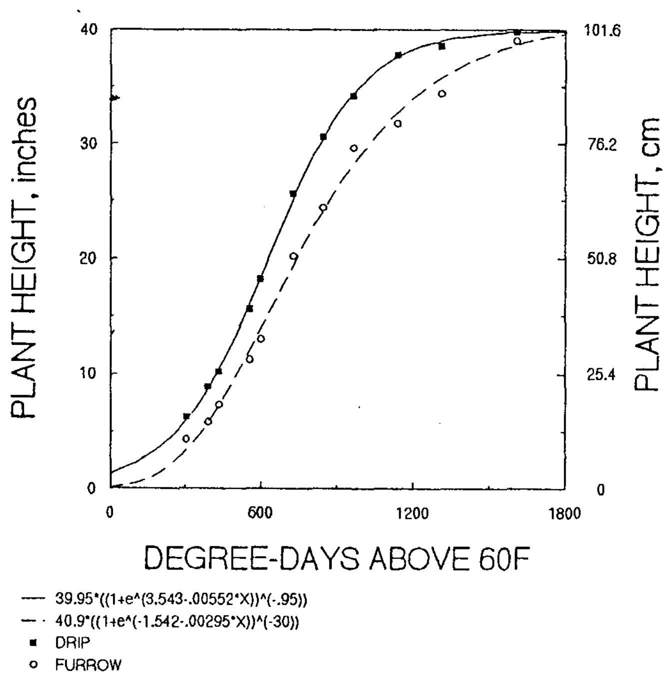

Figure 3. Plant heights 1990, N8577