COMPARISON OF SUBSURFACE DRIP AND FURROW IRRIGATION OF COTTON ON TWO SOIL TYPES USING DEEP EVERY-OTHER FURROW PLACEMENT OF DRIPPERLINE.

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OBJECTIVES: To compare subsurface drip to furrow irrigation of Acala cotton on a good soil (uniform, high silt content) and a poor soil (non-uniform, sand streaks and pockets), by measuring growth characteristics, yields, and water use. Also to verify technical feasibility of drip irrigation and to determine problem areas.

PROCEDURES: Equipment procurement and installation began in the Fall of 1989 for a 1.2 ha field located near the southwest corner of our field South 40. Each plot consisted of eight 0.76-m rows 89 m long. There were 5 replications of the 2 treatments in each soil using a randomized complete block experimental design. In the drip treatment, 20 mm O.D. dripperline was used with 4 L/h in-line emitters spaced every 0.6 m. The emitters were of the labyrinth type and Treflan impregnated (to prevent root intrusion) and were placed in the tubing as it was extruded so that there were no joints in the field. The dripperline was placed 0.4 m below grade under every other furrow. The operating pressure was 136 kPa. Canal water was used for both the drip and furrow treatments. The drip water was filtered by sand-media filters and continuously treated with 20 ppm phosphoric acid. Nitrogen fertilizer was applied through the water for both the drip and furrow treatments. The first half of the season, calcium ammonium nitrate (CAN-17) was used and in the last half potassium nitrate was applied. Plans called for 225 kg/ha of N to be applied altogether, but equipment problems limited the N application to 153 kg/ha. At peak water use, furrow irrigation occurred once a week, the amount applied determined by neutron probe readings and a special computer program that helped track soil moisture. Probe readings were taken before and after every irrigation. Infiltration rates were also measured every irrigation using a modified stream advance method along with inflow-outflow measurements. The drip system applied water several times a day using an automated evaporation pan and a special program in a micrologger designed for pan control. A polynomial pan coefficient was multiplied by the hourly pan evaporation, and when the total reached 2 mm, that amount was applied to the field. Operation was limited to daytime application only. The micrologger was accessed by phone from desk-top computers both in Fresno and in the Shafter office. Daily printouts were made of the drip system activity, which included flow rates, pressures, irrigations, and pan levels. Status could be monitored at any time, and when needed, the micrologger program could be changed from our offices. At the beginning of the season 153 L/ha of Vapam was applied to the entire plot area through a sprinkler system to control nematodes.

RESULTS: The field with the "good" soil was about 98% good. The field with the "poor" had varying amounts of good soil in each plot, the amount determined by measuring the areas enclosed by a sharp line of demarcation seen in the height of plants. In the good soil, the drip plot yield was the same as the furrow plots at 1940 kg/ha of lint. In the poor soil the drip treatment out-yielded the furrow plots by 216 kg/ha, the LSD(05) being 162-kg/ha. Using the percent of good soil in each plot as a measured, but uncontrolled variable, it was possible to use covariance analysis to determine what the yields would have been if 100 percent of all plots were poor soil. The results were a lint yield of 1768 kg/ha for the drip treatment and 1563 kg/ha for the furrow treatment on the poor soil. The drip-irrigated plants were consistently taller than the furrow-irrigated plants, and near the end of the season the difference was 0.18 m on both the good and poor soils. The furrow irrigation procedure was as about as efficient as is possible, with only 89 m runs, set times of 8 hours or less, advance ratios of about 8, and a tail-water return system. Even so, the net amount of water applied to the furrow plots for the season was high, 1.17 m on the poor soil and 1.06 m on the good soil. By comparison, the drip treatments used very little water, 0.58 m being applied to on the poor soil and 0.61 m applied to the good soil. The season total for depth of water which infiltrated at the lower end of the fields was almost the same as the depletion measured by the neutron probe data, indicating accurate measurements of infiltration rates.
During the season there was no measurable change in the flow rate to the drip system indicating no clogging, and when the system was re-started in the following Spring there was still no sign of clogging, definitely no problem with root intrusion. There was a surface-sealing problem noted with some of the furrow-irrigated plots, generally occurring in those soils with the best yields.

FUTURE PLANS: Gypsum will be applied to both fields to try to solve the sealing problem. Leaf petiole analysis will be used to better control nitrogen application, and PIX will be applied to the drip treatments on good soil. Vapam will be applied to the furrow treatments through the pre-irrigation furrow water (rather than with sprinklers) at the same rate of 153 L/ha, and the drip treatments will receive 53 L/ha through the drip water. Sprinkler irrigation will be used for pre-irrigation of the drip treatments whenever winter rainfall is insufficient. An attempt will be made to control nitrogen and water on the drip system near the end of the season so that the plants cut out properly. The entire experiment will be repeated for up to 10 years.