USE OF SUBSURFACE DRIP FOR WEED MANAGEMENT IN TOMATOES GROWN UNDER CONSERVATION TILLAGE

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Introduction

Soil and water conserving cropping systems are being developed in the San Joaquin Valley (SJV). Sub-surface drip irrigation (SDI) and conservation tillage (CT) are some techniques being included in these systems. SDI is a water management system that has been researched extensively in the SJV. This system has been shown to reduce percolation below the root zone and subsurface drainage while maintaining crop yields (Phene et al., 1987; Hanson and May, 2004) and providing more efficient water use than furrow irrigation (FI) (Phene et al., 1987; Yohannes and Tadesse, 1998). The moisture in a SDI system is generally confined to the area around the drip line thus keeping the surface dry (Hanson and May, 2004). On the other hand, majority of weed seeds in no-till systems have been found to be located in the surface of the soil (Clements et al., 1996). Because CT may limit weed emergence to the top few inches of soil and SDI may keep the soil surface too dry for weed emergence, these methods may have implications for development of weed suppressive cropping systems in the SJV.

Methods

A 2-year (2004 and 2005) field study was conducted at UC West Side Research and Extension Center, Five Points, CA to assess the effect of SDI and CT on weed densities and biomass in transplanted processing tomato (*Lycopersicon esculentum* Mill.) grown on raised 60 inch beds. The experimental design was a split-split plot with four replications. Tillage system [CT vs standard (ST)] was the main plot, irrigation system [SDI vs furrow (FI)] was the sub-plot, and herbicide [herbicide (WC) vs no herbicide (NWC)] was the sub-sub-plot.

The main plots were 280 ft long and 6 beds wide and were divided into two subplots (3 beds) for the tillage sub-treatments. The CT plots consisted of permanent raised beds without any bed top tillage. The ST plots consisted of standard tillage practices i.e., subsoiling, disking, landplaning, and listing. Listing was done with a 3-bed Wilcox Performer. The subplots were divided into two sub-sub plots which were 3 beds wide and 140 ft long for the weed control treatments. Main plots were separated by 3 beds which served as a buffer.

After the beds were prepared, drip tapes were installed in the SDI plots. Queen Gil medium flow tape was buried 10 in below the surface in the center of the bed. Processing tomato (cv 'H 8892') seedlings was mechanically transplanted in late-April of each year. The FI plots were sprinkle-irrigated immediately after transplant to establish the seedlings. The SDI system was run immediately after transplant and no sprinkler irrigation was used. The SDI plots were

irrigated about 3 times a week while the FI plots were irrigated once a week. Ammonium sulfate was shank applied at the recommended rate in all the FI plots. The SDI plots were fertigated.

The furrows of all the plots were cultivated with a Sukup 9200 3-row cultivator on May 20, 2004. A band application of rimsulfuron (Matrix) was made at 0.5 oz ai/acre on May 20, 2004 in the crop row of the plots designated for weed control. The furrows of the FI plots were cultivated again on June 3, 2004. The SDI plots were not cultivated because there were very few weeds in the furrows. In 2005, the furrows of all the plots were cultivated on May 11. However, because of precipitation early in the season, there were comparatively more weeds in the furrows of all the plots in 2005 than in 2004. Therefore, the furrows of all the plots including the SDI had to be cultivated again on June 1. In 2005, the beds of the WC treatments were hand weeded on May 26 because the plots were too wet for equipment operation early in the season and by the time the plots dried, the weeds were too large for successful postemergence control with an herbicide that was safe enough to prevent injury to tomato plants.

Weed density and species composition were assessed twice during the growing season by randomly sampling 0.25 m^2 quadrat areas. The first sampling was done prior to weed control to assess initial densities and the second sampling to determine new weed emergence. Two random 0.25 m^2-samples were taken on the beds and two in the furrows of each plot. In 2004, the assessments were made on May 12 and June 4. Weed biomass was assessed prior to crop harvest by taking two random 0.25 m^2-samples in the crop row and two in the furrows of each plot.

The treatments were maintained in the same beds in the second year. The CT sub-plots used permanent beds without bed-top tillage. Whereas, after harvest, all the ST beds were stubble disked and mulched in late fall and reshaped with a Wilcox Performer. Glyphosate was applied on March 7, 2005 in all plots to control weeds that had emerged in the fall and winter. Similar fertilizer application methods were used as in 2004. Weed density assessments on the beds and in the furrows were made using similar techniques as in 2004. Tomatoes were mechanically harvested both years in late August.

Results

In both years, weed emergence in the furrows of SDI treatments were almost eliminated. Similarly, weed densities on the beds were 46 to 96% lower in the SDI than FI plots. Tillage did not generally affect weed densities but interacted with irrigation in 2005 when the SDI-CT plots had 87% fewer weeds than SDI-ST plots. Figure 1 shows typical weed densities under the various systems in the second year of the study. Weed biomass on the bed was not affected by irrigation or tillage system but the biomass in the furrows was 90% lower in the SDI than FI plots. Similar results were reported by Sutton et al. (2006). They also found that hand weeding time was 5 to 13 times greater in FI treatments compared to SDI treatments and weed biomass on the beds at tomato harvest was 10 to 14 times greater in the FI than the SDI systems.

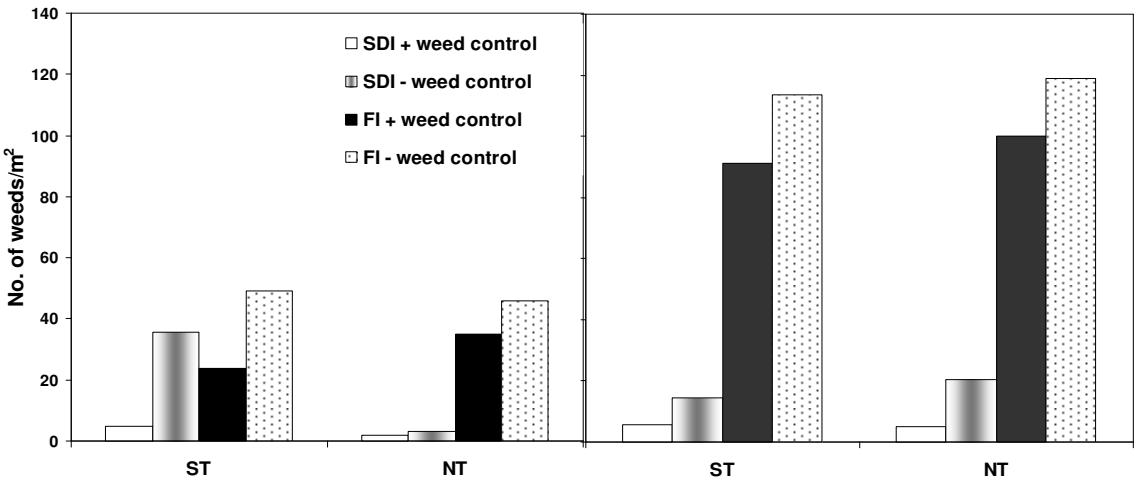

Figure 1. Typical weed densities on the bed (left) and in the furrow (right) under Furrow and Subsurface Drip irrigation in the Standard Tillage and No-Till plots.

This experiment showed that SDI could be used as a weed management tool for ST and CT tomato production. The weeds in the furrows could be almost eliminated with SDI. In years of low winter precipitation, the SDI plots did not require cultivation of the furrows whereas the FI systems required at least two cultivations. Total and marketable tomato fruit yields were lower under SDI compared to FI systems. However, tillage had no effect on either total or marketable fruit yield. The study showed that water management was an important factor in attaining comparable fruit yields between SDI and FI systems. Early irrigation cut-off and leakages in the SDI system may have been responsible for blossom-end rot in the tomato fruits and thus reduction in fruit yield. Tomato fruit quality was not affected by irrigation, tillage, or weed control. A combination of SDI, one-time cultivation in the furrows (based on weed densities), and a weed control treatment on the beds may be a successful weed management strategy in processing tomatoes in the SJV.

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