EFFECT OF IRRIGATION VOLUME ON WETTING PATTERNS IN FLORIDA VEGETABLE SOILS

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Since 1994, various soil applied fumigant alternatives, either alone or in combination, have been field evaluated in Florida vegetable production systems for their potential to replace methyl bromide while maintaining pest control efficacy and crop yield. Significant advancements have been made in the area of soil application technologies for some of these alternative fumigants applied via standard shank or chisel injection. Problems continue with crop and pest control response variability for those soil fumigants applied pre and post plant via drip irrigation delivery systems (chemigation). Most Florida vegetable soils are classified as fine sands with low water holding capacity and high hydraulic conductivity, which allows water to easily, and in some cases the chemical in them, rapidly percolate through soil. The objectives of the research reported herein were to evaluate the spatial distribution of drip irrigation water colored with a blue dye when applied through one or two drip tubes at various irrigation times and total water volumes.

Three field trials were conducted in commercial strawberry production fields at the end of the harvesting season in Plant City, Florida during May, 2001. At each site, soil type was a fine sand, with beds formed, covered with plastic mulch, and new drip tape installed in accordance with normal grower practices. At each site, drip tubing used was either T-Tape®, Netafim®, or Queen Gil®. Emitter spacing for the different tubes varied from 4 to 18 inches, delivering from 0.281 to 1.2 gallons per minute per 100 linear feet of row. Distribution of drip irrigation water for irrigation run times of 1 to 12 hours was evaluated using a water soluble blue marking dye (Signal®). One and two drip tubes per bed were evaluated in all trials. For a single tube per bed, the tube was positioned on the bed top center, while the two tubes were centrally positioned 10-12 inches apart adjacent to established plants in 2 rows down the mulched covered row.

Width, depth and area of soil covered by the drip water were evaluated by digging cross sections across the beds to the depth of the wetting front. For all trials, with single drip tubes, cross sections and measurements of drip water dispersion were made across the bed at points on the emitters and equidistant between emitters. In all cases, cross sectional observations were made at two random locations per replicate plot for each treatment. To measure the spatial distribution of drip water, a 36 inch square plexiglass sheet, scored at 1 inch intervals in both directions, was held against the bed face to be measured and the bed and water distribution pattern outlined with an erasable felt pen. Mapped grid coordinates were then field recorded and later

entered into the computer to analyze depth, width, and size of treated or dye stained areas relative to bed size, irrigation run time, water volume, drip tube number, and other treatment regimes.

For measurements taken on the drip emitter and a single drip tube per bed, the depth, width, and cross sectional bed area wetted by drip irrigation water increased linearly with irrigation run time from 1 to 12 hours at all grower field experimental sites. As with patterns measured with a single tape on the emitters, increases in width, depth and area were generally linear when measurements were procured at points midway between drip emitters. At one of the sites, the presence of a shallow compacted traffic layer severely restricted downward penetration of drip water, and resulted in the flooding of row middles after irrigation run times of longer than 4 hours. The use of two drip tubes per bed only expedited the time in which flooding occurred within the field. In general, convergence of the wetting fronts midway between emitters was a much slower process as distance increased between emitters. For preplant soil fumigation purposes therefore, where maximum bed coverage along the entire bed is important, emitters which are to widely spaced along the row are likely to compromise overall treatment efficacy with any chemigated, soil fumigant compound.

The relation between drip irrigation run time and depth, width, and cross sectional bed area wetted by drip irrigation water were very different between experimental sites and could not be directly compared due to variations in irrigation run time, line operating pressure, drip tube flow rate (high, medium, low), in addition to differences in tube numbers per bed and emitter spacing. However, average depth, width, and cross sectional bed area wetted by drip irrigation water was determined to increase as a direct allometric function of total water volume applied, and the functional relationship was remarkably similar for all experimental sites. For the irrigation run times and total water volumes evaluated in these studies, there was little indication that one drip tube manufacturer was any different from another when equal volumes of irrigation water were compared. For a given water volume, the use of two tapes per bed always increased spatial distribution of irrigation water simply because of the spacing between drip tubes and the increased number of emission points along the bed. In the overall analysis of the relationship between total irrigation water volume and spatial distribution of the wetted zone, it appears that most bed wetting occurs in the time to deliver the first 300 gallons of water expressed per 100 linear feet of row. If a maximum depth of 16-20 inches from the top of the bed is assumed, then irrigation run times required to deliver water volumes of 100 to 200 gallons per 100 linear feet of row should not be exceeded so as to contain the wetting front within the future rooting zone of the plant.

General Conclusions:

- **Regardless of drip tube manufacture, irrigation run time, tube flow rate, emitter spacing, or total volume water applied, it was virtually impossible to wet more than 50-60% of the bed with a single drip tube per bed.**

- **In the sandy soils of Florida and discounting fuming action, two drip tubes will be required to treat upwards of 85-95% of the entire mulch covered bed with any chemigational alternative to methyl bromide.**
- **For the sandy soils of Florida, most bed wetting seems to occur in the time to deliver the first 300 gallons of water expressed per 100 linear row feet, and that lesser volumes should be considered if depth of penetration of the wetting front is an important consideration .**
- **It would appear that irrigation injection schedules previously utilized to evaluate drip applied fumigants in Florida field research have significantly underestimated water volume requirements for maximizing bed coverage.**