

## **DRIP FUMIGATION: WATER AND FUMIGANT DISTRIBUTION IN SOIL**

Husein Ajwa, Tom Trout, Shad Nelson, and Mary Schutter  
USDA-ARS, Water Management Research Laboratory, Fresno, CA

Drip fumigation with alternative fumigants to methyl bromide [1,3-dichloropropene (1,3-D), chloropicrin (Pic), methyl isothiocyanate (MITC), iodomethane (IM), and propargyl bromide (PrBr)] may provide a more uniform distribution of chemicals in the soil than shank injection. Our earlier studies found that higher amounts of irrigation water would result in greater fumigant concentration in the gas phase across the soil profile. Factors affecting water distribution around a drip line include soil hydraulics (water holding capacity and unsaturated hydraulic conductivity, initial soil water content, etc.), water application rate, drip system specification (emitter spacing and distance between the drip lines), and soil bed configuration (height and width of the bed). The objective of this study was to evaluate fumigant distribution in soil relative to water movement in drip fumigated soil beds for various soil types and under different configurations of the drip irrigation systems.

### **Methods**

Water distribution and soil gas concentrations of Pic, 1,3-D, MITC, IM, and PrBr (applied as Pic EC, InLine, metam sodium, IM/Pic mixture, and PrBr/toluene) in the soil profile were monitored following drip fumigation for 10 days. These studies were conducted on three soil types and several drip tape and bed configurations commonly used in California.

### **Results**

Figures 1 and 2 show examples of water movement and Pic distribution in a Watsonville sandy loam soil approximately 6, 24, and 72 h following drip fumigation with Pic EC (225 kg ha<sup>-1</sup>) using 50 mm of irrigation water. Redistribution of the water occurred within the first 24 h after irrigation with a uniform distribution throughout the bed (Figure 1). The distribution of Pic initially follows the water distribution pattern, but fumigant and water distribution patterns differ considerably 24 hrs after fumigation (Figure 2). A large portion of Pic remained within the upper 30 cm of the soil bed and its downward movement appeared to be less than that of other fumigants (e.g., IM). The contour lines demonstrate how Pic did not readily move with the total applied water as concentrations in the soil air continually decreased in the lateral and downward directions from the bed center, possibly due to its short half-life in soil (1 d) and low water solubility (0.20 %).

Except for MITC, all other fumigants studied diffuse in the soil gaseous phase beyond the waterfront. MITC distribution in soil initially follows the water distribution patterns, but unlike other fumigants, the distribution patterns do not change over time. Moreover, MITC disappears from the soil gaseous phase at faster rates than other fumigants. This research explains distribution patterns of various fumigants in relation to their physico-chemical properties and environmental conditions.

Figure 1

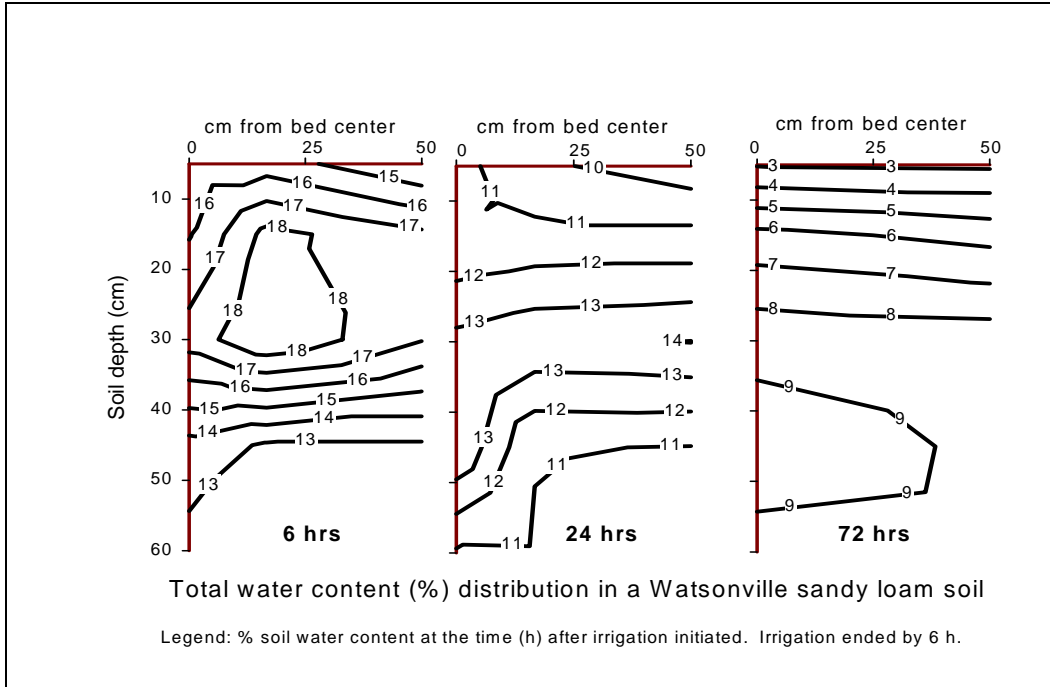


Figure 2

