WATER AND METHYL ISOTHIOCYANATE DISTRIBUTION IN SOIL AFTER DRIP FUMIGATION WITH METAM SODIUM

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Metam sodium (N-methyl dithiocarbamate), which rapidly degrades in soil into methyl-isothiocyanate (MITC), has been extensively used to control weeds, nematodes, and soilborne fungal pathogens. Our research determined the movement of water and MITC in drip-fumigated soils after application of Metam sodium through various configurations of drip irrigation systems. The effects of varying drip irrigation flow rate and total water application amount were evaluated for optimum MITC and water distribution in a sandy loam soil.

Methods

Drip fumigation studies were performed on a Hanford sandy loam soil at the USDA-Agricultural Research Station research station, Parlier, CA. Metam sodium (Vapam HL) was applied via drip irrigation lines placed 2-5 cm below the surface in the middle of soil beds (86 cm wide) covered with clear high density polyethylene (HDPE) film. Two studies were conducted. In the first study, metam sodium was applied at a rate of 2.5 L h^{-1} m^{-1} through drip tape with 30 cm emitter spacing in varying water amounts (25, 50, and 75 mm irrigation depth with a metam sodium concentration in water of 980, 490, and 327 mg L^{-1}, respectively). In the second study, metam sodium was also applied in 55 mm water (490 mg L^{-1}) through drip tapes of varying flow rates (1.9, 5.0, and 7.5 L h^{-1} m^{-1} using drip tape with 20, 20, and 10 cm drip emitter spacings, respectively). Water content and MITC concentrations were monitored at three locations in the soil bed (0, 20, and 40 cm from bed center) to a depth of 0, 10, 20, 30, 40, 50 and 60 cm at each of the three locations.

Summary of Results

Water application rate and the amount of application water used in drip fumigation have a strong influence on soil distribution MITC. Drip lines with flow rates greater than 5 L h^{-1} m^{-1} or water application amounts less than 50 mm do not provide adequate chemical and water distribution throughout the soil bed (Figures 1 and 2). Cumulative concentrations of MITC in soil to a depth of 60 cm showed that the majority of MITC is released into the soil-air phase rapidly within the initial 24 h after irrigation (Figure 3). The low irrigation amount (25 mm water) led to a low concentration of MITC in the soil, suggesting that this amount of water was not sufficient to form a water seal to prevent MITC volatilization, thus causing subsequent low soil-air MITC concentrations.

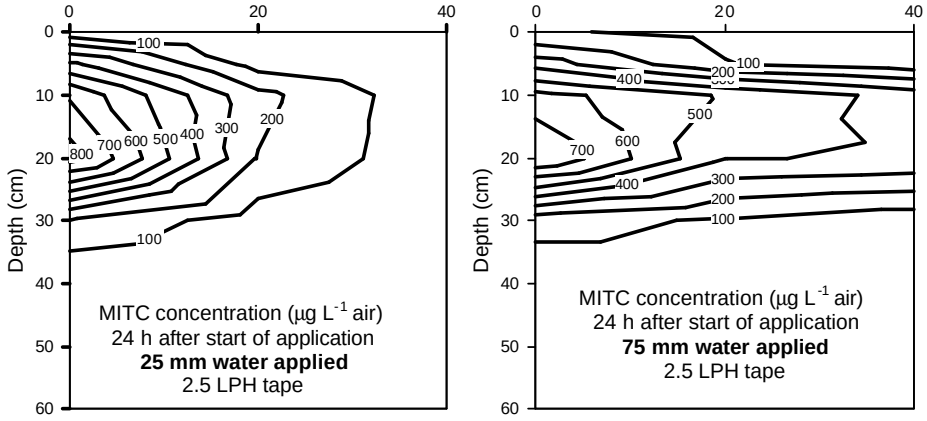

Figure 1. Soil-air MITC concentration after drip fumigation using varying irrigation amounts. Data collected from 0 (center), 20, and 40 cm.

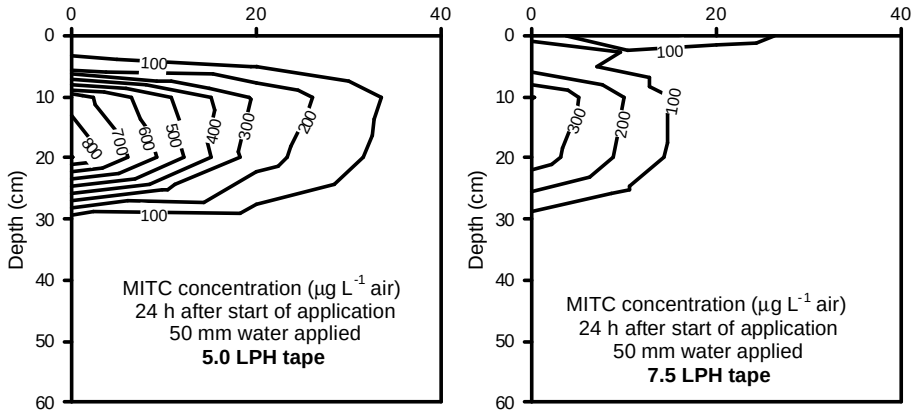

Figure 2. Soil-air MITC concentration after drip fumigation using varying drip tape flow rate. Data collected from 0 (center), 20, and 40 cm

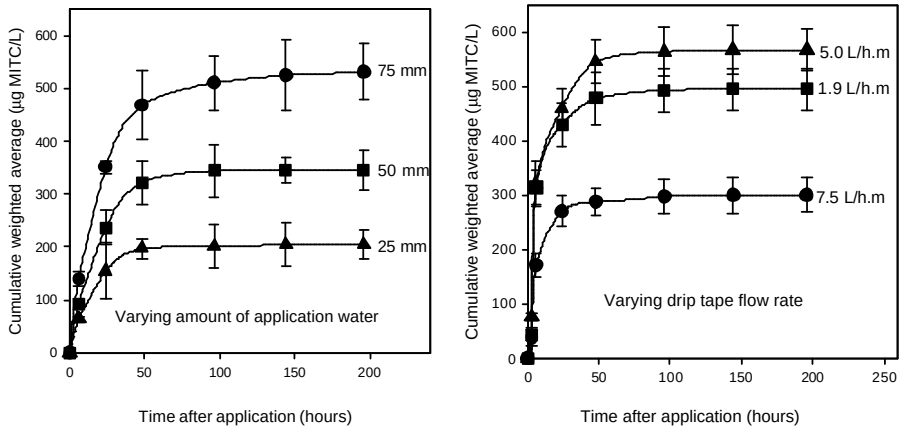

Figure 3. Cumulative concentration (weighted average) within 60 cm soil depth after drip fumigation of metam sodium in three amounts of water (25, 50, and 75 mm) and at three flow rates (1.9, 5.0, and 7.5 L/h.m).